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Agilent Technologies

HEWLETT
PACKARD

Service Manual

HP 5528A
Laser Measurement System

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Printed: April 1995

Printed in USA

Manual part number
05528-90023

Certification

Hewlett-Packard Company certifies that this product met its published specification at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (formerly National Bureau of Standards), to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

Warranty

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of three years from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective. For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designed by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THAT IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

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THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

Assistance

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

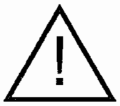
For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

Safety Considerations

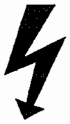
General

This product and related documentation must be reviewed for familiarization with this safety markings and instructions before operation.

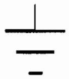
Warning Symbols That May Be Used In This Book



Instruction manual symbol; the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual.



Indicates hazardous voltages.



Indicates ground terminal.

WARNING

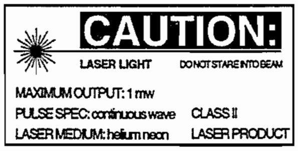
BODILY INJURY OR DEATH MAY RESULT FROM FAILURE TO HEED A WARNING. DO NOT PROCEED BEYOND A WARNING SIGN UNTIL THE INDICATED CONDITIONS ARE FULLY UNDERSTOOD AND MET.

CAUTION

Damage to equipment, or incorrect measurement data, may result from failure to heed a caution. Do not proceed beyond a *CAUTION* sign until the indicated conditions are fully understood and met.

These CAUTION labels are required by the United States Center for Devices and Radiological Health. Failure to follow their instructions may result in personal injury.

This symbol indicates laser radiation.



CAUTION:

LASER LIGHT DO NOT STARE INTO BEAM

MAXIMUM OUTPUT: 1 mw
PULSE SPEC: continuous wave CLASS II
LASER MEDIUM: helium neon LASER PRODUCT

CAUTION: Laser radiation when open.
DO NOT STARE INTO THE BEAM

Hewlett-Packard Company
Santa Clara Division
5301 Stevens Creek Boulevard
Santa Clara, California 95052-8059

HP 5528A
LASER MEASUREMENT SYSTEM

SERVICE MANUAL

Including:

5518A	Laser Head
5508A	Measurement Display
05508-60021	Remote Control Unit
10751A/B	Air Sensor
10757A/B/C	Material Temperature Sensors
10753A	Tripod
10759A	Footspacing Kit
10766A	Linear Interferometer
10767A	Linear Retroreflector
10770A	Angular Interferometer
10771A	Angular Reflector
10772A	Turning Mirror
10773A	Flatness Mirror
10774A	Short Range Straightness Optics
10775A	Long Range Straightness Optics
10776A	Straightness Accessory Kit
10777A	Optical Square
10784A	Base
10785A	Height Adjuster and Post
55280A	Linear Measurement Kit
55281A	Angular Optics
55282A	Flatness Accessory Kit
55283A	Straightness Measurement Kit

SERIAL PREFIX EFFECTIVITY

This manual applies directly to HP 5528A equipment with the serial prefixes listed in Table 1-1. Lower number serial prefixes are covered in Section VII. Higher number serial prefixes are documented with "Manual Changes" supplements as described in Paragraph 1-10.

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5301 STEVENS CREEK BLVD, SANTA CLARA, CA 95052-8059

MANUAL PART NUMBER : 05528-90023

Printed: February 1996

HEWLETT® PACKARD

Warranty (con't)

For warranty service or repair, this product must be returned to a service facility designed by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designed by HP for use with an instrument will execute its programming instructions with properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplies software or interfacing, unauthorized modification or misuse, operation outside the environmental specifications for the product, or improper site preparation or maintenance.

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Assistance

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

Warning

Any interruption of the protective grounding conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two-conductor outlet is not sufficient protection.)

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to the earthed pole terminal (neutral) of the power source.

For continued protection against fire, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example, normal blow, time delay). Do not use repaired fuses or short circuited fuseholders.

Laser Head Safety Considerations

CAUTION

LASER RADIATION IS EMITTED FROM THE APERTURE ON THE 5518A LASER HEAD AS ILLUSTRATED ON THE FOLLOWING PAGE. DO NOT STARE INTO BEAM. THIS PRODUCT IS A CLASS II LASER PRODUCT CONFORMING TO FEDERAL BUREAU OF RADIOLOGICAL HEALTH REGULATIONS 21 CFR 1040.10 AND 1040.11 AND TO INTERNATIONAL LASER SAFETY REGULATIONS. THE MAXIMUM RADIANT POWER OUTPUT IS 1 MILLIWATT. THE PULSE SPECIFICATION IS CONTINUOUS WAVE,

Safety Considerations (con't)

THE LASER MEDIUM IS HELIUM-NEON, AND THE WAVELENGTH IS 632.991 NANOMETERS.

USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE.

Acoustic Noise Emissions

HP 5508A
LpA <48.1 dB at operator position, at normal operation, tested per EN 27779. All data are the results from type test.

HP 5518A
LpA <40 dB; no fan installed.

Geräuschemission

HP 5508A
LpA<48.1 dB am Arbeits platz, normaler Betrieb, geprüft nach EN 27779. DieAngagen beruhen auf Ergebnissen von Typprüfungen.

HP 5518A
LpA <40 dB; kein Ventilator eingebaut.

Electrostatic Discharge Immunity Testing

When the product is tested with 8kV AD, 4kV CD and 4kV ID according to IEC 801-2, a system error may occur that may affect measurement data made during these disturbances. After these occurrences, the system has to be reset to continue operation.

Radio Frequency Interference

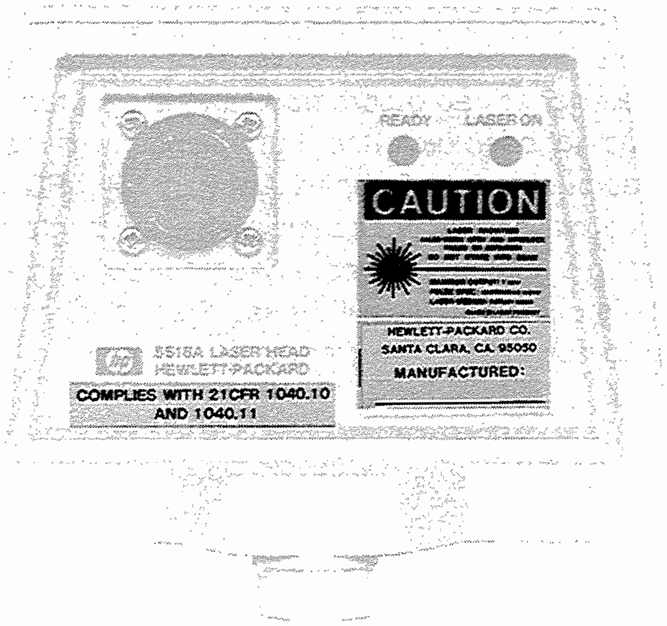
This is a Class A product. In a domestic environment this product may cause radio interference, in which case, the user may be required to take adequate measures.

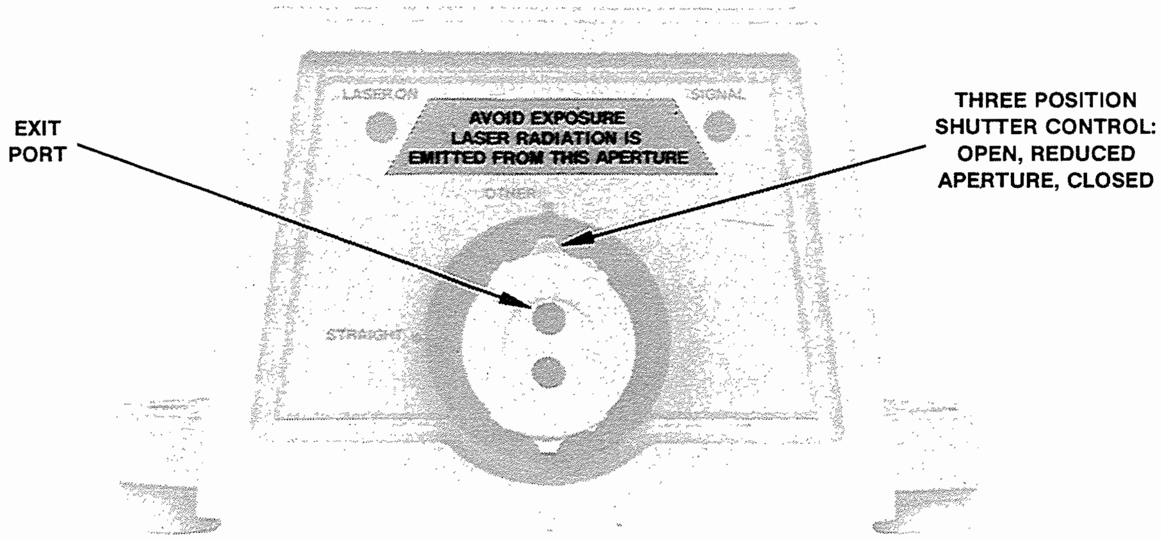
LASER HEAD SAFETY LABELS

CAUTION

LASER RADIATION
(ALSO WHEN OPEN AND INTERLOCK
FAILED OR DEFEATED)
DO NOT STARE INTO BEAM

MAXIMUM OUTPUT: 1 mw
PULSE SPEC: continuous wave
LASER MEDIUM: helium neon
CLASS II LASER PRODUCT


READY
LASER ON
CAUTION
HEWLETT-PACKARD CO.
SANTA CLARA, CA. 95050
MANUFACTURED:
5518A LASER HEAD
HEWLETT-PACKARD
COMPLIES WITH 21CFR 1040.10
AND 1040.11


EXIT
PORT
THREE POSITION
SHUTTER CONTROL:
OPEN, REDUCED
APERTURE, CLOSED
LASER ON
SIGNAL
AVOID EXPOSURE
LASER RADIATION IS
EMITTED FROM THIS APERTURE
OPEN
STRAIGHT

(U.S.A. ONLY)

FEDERAL COMMUNICATIONS COMMISSION RADIO FREQUENCY INTERFERENCE STATEMENT

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

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SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This Service Manual contains information required to install, test, adjust, and service the Hewlett-Packard Model 5518A Laser Measurement System. It is intended primarily for use by those concerned with installing and servicing the system. A separate User's Guide is supplied that describes information required to setup, align, and apply the system to various types of measurements. Sufficient operating information is presented in this manual to allow service personnel to repair the instruments available for the system.

1-3. The HP part number of this manual is listed on the title page.

1-4. MANUAL ORGANIZATION

1-5. This Service Manual is organized as follows:

SECTION I GENERAL INFORMATION covers Manual Organization, Instruments Covered by the Manual, Safety Considerations, Specifications, System Description, Equipment Descriptions, Optical Kits, Compatible Equipment, System Configurations, Recommended Test Equipment, and Warranty Information.

SECTION II INSTALLATION covers Preparation for Use, Power Requirements, Line voltage and Fuse Selection, Interconnecting Cabling, Operating and Storage Environments, Storage and Shipment, and Packaging.

SECTION III OPERATION provides operating information for the Service Technician and covers Equipment Front and Rear Panel Features, Error Messages, Operator's Check, Self Test and Warm-up Countdown description, Data Transfer to External Devices, Instrument Function Codes, HP-IB Operation, HP-IB Switches, and Operator's Maintenance. A separate User's Guide is supplied for those concerned with applying the system to perform precision measurements.

SECTION IV PERFORMANCE TESTS provides Safety Considerations, Calibration Procedures and Cycles, HP-IB Diagnostics, and a Test Record.

SECTION V ADJUSTMENTS covers Safety Considerations, Adjustment Procedures, Test Equipment Required, and an Adjustment Record.

SECTION VI REPLACEABLE PARTS includes Tables of Replaceable Parts, including illustrated parts breakdowns of chassis and mechanical assemblies, Abbreviations, and Ordering Information.

SECTION VII MANUAL CHANGES describes how to update or backdate the manual for prefixes other than those listed in Table 1-1.

SECTION VIII SERVICE contains Safety Considerations, Theory and Block Diagram Descriptions, Trouble Isolation, Troubleshooting, Disassembly Procedures, Schematics, and Component Locations.

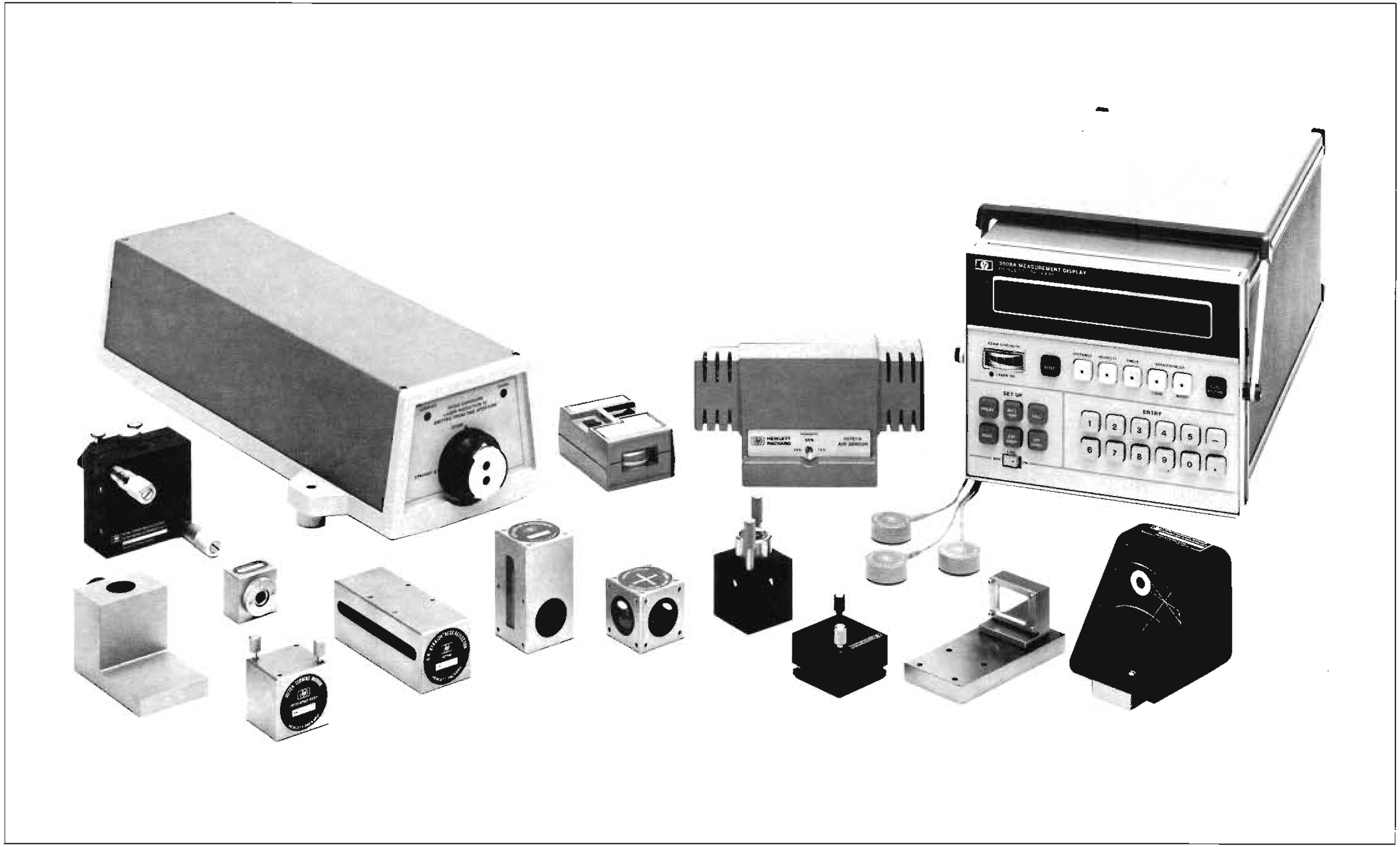

Figure 1-0. Typical 5528A Laser Measurement System

Figure 1-0

TYPICAL 5528A LASER MEASUREMENT SYSTEM

(See Page 1-0)

SECTION I
GENERAL INFORMATION

Introduction, Serial Numbers, Safety, Specifications, Descriptions, System Configurations, Test Equipment, Warranty

SECTION II
INSTALLATION

Initial Inspection, Preparation for Use, Interconnecting Cables, HP-IB Cables, Storage and Shipment

SECTION III
OPERATION

5508A Controls, 5518A Controls, Compensation, Error Messages, Operating Instructions, HP-IB Operation, Operator Maintenance

SECTION IV
PERFORMANCE CHECKS

Equipment Required, Test Record, Operational Verification, Calibration Cycle, Calibration Procedures, Performance Tests

SECTION V
ADJUSTMENTS

Equipment Required, Factory Selected Components, Adjustment Procedures

SECTION VI
REPLACEABLE PARTS

Abbreviations, Ordering Information, Direct Mail Order System, PC Board Replaceable Parts, Exploded Views and Chassis Parts

SECTION VII
MANUAL CHANGES

Newer Instruments, Older Instruments

SECTION VIII
SERVICE

Theory, Trouble Isolation, Troubleshooting, Component Locators, Schematic Diagrams

HOW TO LOCATE INFORMATION

Three methods are used to assist in locating information, a Table of Contents preceding Section I, a Tab System that divides the manual into sections and subsections, and an alphabetical index of subjects located at the back of the manual.

The Table of Contents lists all first, second and third paragraph headings, all Tables, and all Figures used throughout the manual.

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SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This Service Manual contains information required to install, test, adjust, and service the Hewlett-Packard Model 5528A Laser Measurement System. It is intended primarily for use by those concerned with installing and servicing the system. A separate User's Guide is supplied that describes information required to setup, align, and apply the system to various types of measurements. Sufficient operating information is presented in this manual to allow service personnel to repair the instruments available for the system.

1-3. The HP part number of this manual is listed on the title page. Also listed is a microfiche part number which may be used to order 4- × 6-inch microfilm transparencies of the manual. The microfiche package also includes the latest "Manual Changes" supplement and any pertinent Service Notes.

1-4. MANUAL ORGANIZATION

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SECTION VI REPLACEABLE PARTS includes Tables of Replaceable Parts including illustrated parts breakdowns of chassis and mechanical assemblies, Abbreviations, Ordering Information, and the HP Direct Mail Order System.

SECTION VII MANUAL CHANGES describes how to update or backdate the manual for prefixes other than those listed in Table 1-1.

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1-6. HOW TO LOCATE INFORMATION

1-7. Three methods are used to assist in locating information, a Table of Contents preceding Section I, a Tab System that divides the manual into sections and subsections, and an alphabetical index of subjects located at the back of the manual.

1-8. The Table of Contents lists all first, second and third paragraph headings, all Tables, and all Figures used throughout the manual.

1-9. The Tab System divides the contents of the manual into sections. In addition, tabs are used to divide Section VIII into subsections for each instrument to allow for easy access of service information. Tabs are provided for the 5528A, 5508A, 5518A, 10751A/B, 10757A/B/C, and the Optics. A section Table of Contents is included on the backside of each tab divider.

1-10. INSTRUMENTS COVERED BY THE MANUAL

1-11. Table 1-1 lists the instruments, optics, and accessories that comprise the 5528A Laser Measurement System. Table 1-1 also lists the equipment's serial prefixes that this manual applies to. Equipment with lower numbered serial prefixes than those listed in Table 1-1 are covered in Section VII, Backdating. Higher numbered serial prefixes are documented with a "Manual Changes" supplement printed on yellow paper.

1-12. Attached to each instrument of the 5528A System is a serial plate. The serial number is in the form: 0000A00000 or 1A00000 on instruments where serial number space is limited. It is in two parts; the first digits and the letter are the serial prefix and the last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The suffix is assigned sequentialy and is unique to the individual instrument. The contents of this manual apply to instruments with the serial number prefixes listed in Table 1-1.

1-13. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed in Table 1-1. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow "Manual Changes" supplement. This supplement contains updating information that explains how to change the manual to be applicable to newer instruments.

1-14. In addition to the new series prefix change information, the supplement may contain information for correcting errors in the manual (errata). To keep this manual as current and as accurate as possible Hewlett-Packard recommends that you periodically request the latest "Manual Changes" supplement. The supplement for this manual is identified with the manual print date and part number, both of which appear on the manual title page. Complementary copies of the supplement are available. If you order additional equipment for your system after the initial system order, this manual may not contain applicable documentation for the new equipment. Contact your local sales and service office for manual updating information.

Table 1-1. 5528A Equipment and Manual Serial Prefix Effectivity

5528A System Component	Manual Serial Prefix Effectivity
5508A Measurement Display	3124A
5518A Laser Head	3020A
10751A/B Air Sensor	2452A
10757A/B/C Material Temperature Sensor	2416A
05508-60021 Remote Control Unit	2108A
10753A Tripod	None
10759A footspacing Kit	2216A
10766A Linear Interferometer	1A
10767A Linear Retroreflector	1A
10770A Angular Interferometer	1A
10771A Angular Reflector	1A
10772A Turning Mirror	1A
10773A Flatness Mirror	1A
10774A Short Range Straightness Optics	1A
10775A Long Range Straightness Optics	1A
10776A Straightness Accessory Kit	2216A
10777A Optical Square	2216A
10784A Base	2216A
10785A Height Adjuster and Post	None

1-15. SAFETY CONSIDERATIONS

1-16. The 5518A system is a Safety Class I product and has been designed and tested in accordance with international safety standards, including HD 194 and IEC* 348. It is also a Class II Laser Product certified as conforming to Bureau of Radiological Health Regulations 21 CFR** 1040.10 and 1040.11, and to international laser safety regulations. The instruments and the manual should be inspected and reviewed for safety markings and instructions before operation. A safety summary is included on the page following the title page.

1-17. SPECIFICATIONS

1-18. Table 1-2 lists specifications and performance characteristics for the 5528A Laser Measurement System.

---

*IEC = International Electrotechnical Commission
**CFR = Code of Federal Regulations (U.S.A.)

Table 1-2. Specifications and Supplemental Characteristics

GENERAL

Basic Measurements: The measurements that can be made with the system are Distance, Velocity, Angle, Short Range Straightness, and Long Range Straightness. Each requires appropriate optical components. Flatness is derived from Angle. Parallelism and Squareness are derived from Straightness.

System Configuration: The minimum system includes an HP 5508A Measurement Display, an HP 5518A Laser Head, and optics and accessories for each desired measurement type. An HP 10751A/B Air Sensor may be added to compensate for changes in the velocity of light due to the temperature, pressure, or relative humidity of the air. From one to three 10757A/B/C Material Temperature Sensors may be added to compensate for the expansion or contraction of material with temperature.

Environmental Conditions:

Temperature (Operating): 0-40°C (32-104°F)

Temperature of optical products must be stabilized to ±2°C.

Relative Humidity (Operating): 0-95% Non-condensing.

Vibration: All product designs have been tested to withstand 0.25 mm (0.010 inch) peak-to-peak excursion at 10-55 Hz for 15 minutes and 30 g shock for 11 milliseconds on each of three orthogonal axes.

Power Requirements:

Source: 100, 120, 220, or 240 V (-10%, +5%)

Frequency: 48-66 Hz

Consumption: 175 VA maximum

Maximum Allowable Beam Power Loss: The system will operate normally with up to 95% laser beam power loss in one beam (either reference or measurement) or up to 80% loss in each when both beams are affected.

HP 5508A MEASUREMENT DISPLAY

Description: The HP 5508A Measurement Display is a microprocessor based instrument that controls the 5518A Laser Measurement System. It supplies power to the entire system. It contains circuits to process signals from the 5518A Laser Head and from the HP 10751A/B and HP 10757A/B/C sensors. The front panel has a keyboard that may be used to set up measurements. The instrument can display measurement results and setup parameters or output these to another instrument for processing, storing, or plotting. Some of the capabilities of the HP 5508A are described below under the heading SYSTEM OPERATING CHARACTERISTICS.

Dimensions:

Main Unit: 45 × 23 × 19 cm

Remote Control Unit: (Excluding cable) 87 × 61 × 38 mm

Weight:

Main Unit: 8.7 kG

Remote Control Unit: (Including cable) 700 grams

HP 5518A LASER HEAD

[illegible]

Description: The HP 5518A Laser Head contains an automatically-tuned helium-Neon laser, circuits to control the laser, and optical receivers. The laser generates a coherent, collimated, two frequency beam of light. This is a Class II Laser Product conforming to Federal Bureau of Radiological Health Regulations 21 CFR 1040.10 and 1040.11.

Split Frequency: 1.7 - 2.4 MHz

Vacuum Wavelength: 632.991 nanometres

Vacuum Wavelength Stability: $\pm 2 \times 1^{-8}$, typical

Wavelength Stability:

Short Term (1 Hour): ±0.002 ppm, typical

Long Term (lifetime): ±0.02 ppm, typical

Beam Diameter: 6mm typical

Maximum Power: Output: 1mW

Warm-up Time: less than 10 minutes (4 minutes typical)

Dimensions: 48 × 19 × 12 cm

Weight: 5.5 Kg

HP 10751A/B AIR SENSOR

Description: The 10751A/B contains sensors for measuring air temperature and air pressure. It has a switch to select relative humidity. A cable is attached for connection to the HP 5508A Measurement Display.

Cable Length:

10751A: 5m (16 feet)

10751B: 15 m (49 feet)

Operating Range:

Temperature: 0-40°C (32 -104°F)

Absolute Pressure: 517.2-775.7mm Hg (20.4-30.5 in Hg)

Table 1-2. Specifications and Supplemental Characteristics (Continued)

HP 10751 A/B AIR SENSOR (Continued)

Twelve Month Calibration Interval Sensor Accuracy:

Operating Temp Ranges	Max Air Pressure Error	Max Air Temperature Error
20° C	1.80 mm Hg	0.55° C
15-25° C	2.20 mm Hg	0.60° C
0-40° C	4.20 mm Hg	1.15° C

If the 10751A/B Air Sensor is incorrectly mounted, add 2° to the listed temperature errors.

Zero Month Calibration Interval Sensor Accuracy:

Operating Temp Ranges	Max Air Pressure Error	Max Air Temperature Error
20° C	0.60 mm Hg	0.45° C
15-25° C	1.40 mm Hg	0.50° C
0-40° C	3.80 mm Hg	1.10° C

If the 10751A/B Air Sensor is incorrectly mounted, add 2° to the listed temperature errors.

Dimensions: (Excluding cable) 18 × 8 × 10 cm

Weight:
10751A: 840 grams
10751B: 1.5 Kg

HP 10757A/B/C MATERIAL TEMPERATURE SENSOR

Description: The 10757A/B/C contains a thermistor type temperature sensor mounted in a remote oil immersible "button" with a magnetic base. A cable is attached to the button for connection to the HP 5508A Measurement Display. Up to three Material Temperature Sensors can be used in the system.

Cable Lengths:
10757A: 5m (16 feet)
10757B: 15m (49 feet)
10757C: 25m (82 feet)

Maximum Sensor Error:
(With 12 month calibration interval)
Over Temperature Range 0-40° C:
±0.10° C when cal match adjusted for a particular HP 5508A Measurement Display.
±0.35° C unadjusted.

Dimensions: (Excluding cable) 32 mm diameter × 15 mm height

Weight:
10757A: 255 grams
10757B: 525 grams
10757C: 795 grams

HP 55280A LINEAR MEASUREMENT KIT

HP 10766A LINEAR INTERFEROMETER

Description: The Linear Interferometer is designed to be used with two Linear Retroreflectors for making linear distance measurements. One Linear Interferometer is supplied with each Linear Measurement Kit.

Alignment Requirements Relative to the Laser Head:
(With the reference reflector mounted above or below the interferometer)
Pitch: ±2°
Yaw: ±5°
Roll: ±1°

Alignment Requirements Relative to the Laser Head:
(With the reference retroreflector mounted on the side of the interferometer)
Pitch: ±5°
Yaw: ±2°
Roll: ±1°

Dimensions: 40 × 40 × 40 mm

Weight: 310 grams

HP 10767A LINEAR RETROREFLECTOR

Description: The Linear Retroreflector is designed to be used with the Linear Interferometer. One retroreflector attaches to the interferometer to establish a reference beam path. A second retroreflector is used in the measurement beam path. The system measures changes in the distance between the interferometer and the measurement retroreflector. Two Linear Retroreflectors are supplied with each Linear Measurement Kit.

Alignment Requirements of the Measurement Retroreflector:
Normal to Incident Beam: ±10°
Roll: Not critical

Dimensions:
Without Attachment Screws: 40 × 40 × 25 mm
With Attachment Screws: 40 × 40 × 35 mm

Weight: 225 grams

Table 1-2. Specifications and Supplemental Characteristics (Continued)

HP 55280A LINEAR MEASUREMENT KIT (Continued)	
HP 10784A BASE **Description:** The Base is a flat ground stainless steel plate designed to accommodate the Post. It can be used either free standing or clamped to a reference surface. Two Bases are supplied with each Linear Measurement Kit.	**Dimensions:** 90 × 50 × 11.7 mm **Weight:** 365 grams
HP 10785A HEIGHT ADJUSTER AND POST **Description:** The Post can be attached to a Base or to a suitable spindle to provide a secure mounting for optical components. The Height Adjuster is designed to mount onto the Post. It contains the system standard 30 mm square bolt pattern to accommodate the optical components. The adjustment range of the Height Adjuster on the Post is 70 mm. Three Height Adjusters and Posts are supplied with each Linear Measurement Kit.	**Dimensions:** **Height Adjuster:** 72 × 40 × 40 mm **Post:** (Without threaded extension) 19 mm diameter × 110 mm length **Post:** (With threaded extension) 19 mm diameter × 117.5 mm length **Weight:** **Height Adjuster:** 215 grams **Post:** 230 grams
HP 10786A LINEAR/ANGULAR CASE **Description:** The Linear/Angular Case is designed to carry all the optical products and accessory hardware needed to perform linear and angle measurements. It provides protection from both shock and contamination to the components during normal transportation and handling. One Linear/Angular Case is supplied with each Linear Measurement Kit.	**Dimensions:** 47 × 38 × 15 cm **Weight:** 4 Kg, nominal
HP 55281A ANGULAR OPTICS	
HP 10770A ANGULAR INTERFEROMETER **Description:** The Angular Interferometer is designed to be used with the Angular Reflector to make angle measurements. One Angular Interferometer is supplied with each set of Angular Optics.	**Alignment Requirements Relative to the Laser Head:** **Pitch:** ±2° **Yaw:** ±2° **Roll:** ±1° **Dimensions:** 40 × 40 × 72.6 mm **Weight:** 555 grams
HP 10771A ANGULAR REFLECTOR **Description:** The Angular Reflector is designed to be used with the Angular Interferometer to make angle measurements. One Angular Reflector is supplied with each set of Angular Optics.	**Alignment Requirements:** **Pitch/Yaw:** ±10 arc-min autoreflection angle **Roll:** ±1°, relative to the measurement plane **Dimensions:** 40 × 40 × 72.6 mm **Weight:** 650 grams

Table 1-2. Specifications and Supplemental Characteristics (Continued)

HP 55282A FLATNESS ACCESSORY KIT

HP 10759A FOOTSPACING KIT

Description: The Footspacing Kit consists of three separate precision ground plates with hardened surface pads. They are designed to be used with the Angular Interferometer and Angular Reflector to make surface plate flatness measurements. One Footspacing Kit is supplied with each Flatness Accessory Kit.

Foot Pad Wear Spec: USA Fed Spec GGG-P-463

Dimensions:
2 inch: 63.5 × 50 × 12 mm
4 inch: 114 × 50 × 12 mm
6 inch: 165 × 50 × 12 mm

Weight:
2 inch: 230 grams
4 inch: 450 grams
6 inch: 650 grams

HP 10773A FLATNESS MIRROR

Description: The Flatness Mirror is designed to provide multi-direction plane beam bending for surface plate flatness measurements. It is designed to be used with the Angular Interferometer, the Angular Reflector, and the Footspacing Kit. Two Flatness Mirrors are supplied with each Flatness Accessory Kit.

Perpendicularity of Mirror to Foot Pad Plane: ±1 arc-minute

Rotation of Mirror on Base: ±360°

Dimensions: 50 × 110 × 46 mm

Weight: 660 grams

HP 55283A STRAIGHTNESS MEASUREMENT KIT

HP 10774A SHORT RANGE STRAIGHTNESS OPTICS

Description: The Short Range Straightness Optics consist of a matched interferometer and reflector mirror set. These are designed for making straightness measurements. These must be used as a set; an interferometer from one set cannot be used with a reflector mirror from another set. One set of Short Range Straightness Optics is supplied with each Straightness Measurement Kit.

Alignment Requirements:
Interferometer Normal to Beam: ±1°
Interferometer Roll Relative to the Straightness Reflector: ±4 arc-min
Axial Deviation of Reflector Normal to Split Beam Plane: ±1.5 mm

Dimensions:
Interferometer: 32 × 32 × 32 mm
Reflector: 40 × 40 × 110 mm

Weight:
Interferometer: 165 grams
Reflector: 800 grams

HP 10772A TURNING MIRROR

Description: The Turning Mirror consists of a reflector mirror and an adjustable mounting mechanism. The mirror is mounted in the housing at a 45° angle. Attached to the adjustable mount, it serves as a general purpose beam bender. One Turning Mirror is supplied with each Straightness Measurement Kit.

Adjustment Range of Leveling Plate, Two Axes: ±6°

Dimensions:
Mirror: 40 × 40 × 40 mm
Mount: 46 × 46 × 30 mm

Weight:
Mirror: 320 grams
Mount: 190 grams

Table 1-2. Specifications and Supplemental Characteristics (Continued)

HP 55283A STRAIGHTNESS MEASUREMENT KIT (Continued)

HP 10776A STRAIGHTNESS ACCESSORY KIT

Description: The Straightness Accessory Kit consists of a Straightness Retroreflector, an Adaptor Plate for mounting the Straightness Interferometer, a Reflector Mount for providing an adjustable mount for the Straightness Reflector, a Base Assembly to provide a stable platform for the Reflector Mount, two long posts and one short post. One Straightness Accessory Kit is supplied with each Straightness Measurement Kit.

Adjustment Range of Reflector Mount, Two Axes:
-3° to +6°

Dimensions:
Base Assembly: 106 × 51 × 55 mm
Straightness Retroreflector: 75 × 85 × 100 mm
Adapter Plate: 40 × 40 × 10 mm
Reflector Mount: 70 × 120 × 140 mm
Post: 19 mm diameter × 108 mm length, 2 ea.
19 mm diameter × 55 mm length, 1 ea.

Weights:
Base Assembly: 910 grams
Straightness Retroreflector: 375 grams
Adapter Plate: 110 grams
Reflector Mount: 1.8 Kg
Post: 230 grams ea (Qty: 2)
120 grams ea (Qty: 1)

HP 10787A STRAIGHTNESS/SQUARENESS CASE

Description: The Straightness/Squareness Case is designed to carry all the optical products and accessory hardware needed to perform straightness and squareness measurements. It provides protection from both shock and contamination to the components during normal transportation and handling. One Straightness/Squareness Case is supplied with each Straightness Measurement Kit.

Dimensions: 47 × 38 × 15 cm
Weight: 4 Kg, nominal

OTHER OPTICAL PRODUCTS

HP 10775A LONG RANGE STRAIGHTNESS OPTICS

Description: The Long Range Straightness Optics consist of a matched interferometer and reflector mirror set. These are designed for making straightness measurements. These must be used as a set; an interferometer from one set cannot be used with a reflector mirror from another set.

Alignment Requirements:
Interferometer Normal to Beam: ±1°
Interferometer Roll Relative to the Straightness Reflector: ±40 arc-min
Axial Deviation of Reflector Normal to Split Beam Plane: ±1.5 mm

Dimensions:
Interferometer: 32 × 32 × 32 mm
Reflector: 40 × 40 × 110 mm

Weights:
Interferometer: 165 grams
Reflector: 800 grams

HP 10777A OPTICAL SQUARE

Description: The Optical Square consists of an optical square and a precision mounting base. It is used in conjunction with straightness optics to make squareness measurements. Refer to the Straightness Optics Specifications for the associated specs.

Incident to Reflected Beam Perpendicularity: ±2 arc-sec
Specified Angle of Each Optical Square: ±0.1 arc-sec
Alignment Requirement: ±5 arc-min autoreflection angle

Dimensions:
Mirror and Housing: 43 × 145 × 145 mm
Mount: 83 × 140 × 152 mm

Weight:
Mirror and Housing: 1.5 Kg
Mount: 2.5 Kg

Table 1-2. Specifications and Supplemental Characteristics (Continued)

LINEAR DISTANCE AND VELOCITY MEASUREMENTS

Linear Distance Measurement Accuracy: Distance measurements are accurate within the following tolerances depending on the velocity of light compensation method and operating temperature. Values shown apply at a known material temperature with a known coefficient of thermal expansion.[1]

Operating Temperature Range[2]	Velocity of Light (VOL) Compensation Method	
	Manual (VOL Exactly Known in Beam Path)	Automatic[3] (Using 10751A/B Air Sensor)
19.5-20.5° C	±0.1 ppm	±1.5 ppm
15-25° C	±0.1 ppm	±1.7 ppm
0-40° C	±0.1 ppm	±3.0 ppm

Linear Distance Measurement Resolution:
Metric Units Mode: 0.02 micron (0.00002 mm)
English Units Mode: 1 microinch

Velocity Measurement Accuracy: ± 0.1%

Velocity Measurement Resolution:
Metric Units Mode: 0.1 mm/minute
English Units Mode: 0.01 in/minute

Maxiumum Velocity: ± 27000 mm/minute (± 1080 in/mm)

Measurement Range/Axial Separation: Typical, with proper alignment, 15–25° C).

Maximum Separation and Range	Optics Configuration	
	Moving Retroreflector (Interferometer Within 5 Metres of Laser Head)	Moving Interferometer
Axial Separation (Head to Retroreflector)	50 metres (165 feet)	15 metres (50 feet)
Measurement Range (Distance of Travel)	40 metres (130 feet)	15 metres (50 feet)

[1] If automatic material temperature sensing is used, the system error will be increased by Te (ppm).
Te(ppm) = coefficient in ppm/° C × average sensor error in ° C.
(See 10757A/B/C Maximum Sensor Error Specification.)

[2] Temperatures of all system components are stabilized anywhere within the temperature range shown.

[3] 10751A/B mounted in recommended orientation. 12 month calibration interval used. Humidity switch set to position closest to actual humidity. If humidity switch set to 50%, tolerances are 1.75 ppm at 20° C, 2.00 ppm at 15–25° C, and 3.70 ppm at 0–40° C. If 10751A/B mounted incorrectly, add 2 ppm.

[4] With VOL known exactly in the bam path, the accuracy is ± 0.02 ppm if the HP 5518A Laser Head is factory calibrated to MIL STD 45662.

ANGLE MEASUREMENTS

Angle Measurement Accuracy: Angle measurements are accurate within ± 0.2% of displayed value ± 0.05 arc-sec per meter of traveled distance of the moving optic.

Angle Type: Pitch and yaw

Angle Measurement Resolution: 0.1 arc-sec

Angle Measurement Range:
± 36000 arc-sec

Axial Separation: (typical, with proper alignment, 15–25° C, distance between the Laser Head and the Reflector.)
15 Meters (50 feet)

FLATNESS MEASUREMENTS

The following specifications assume that the optional Dimensional Metrology Analysis System is used in conjunction with the HP 5528A to gather, analyze and plot flatness calibration results and that the temperature of all optical components is stabilized in the range 15-25° C. Values do not include effects of surface cleanliness or operator positioning repeatability.

Flatness Measurement Accuracy:
±0.2% of displayed value

Flatness Measurement Resolution (Per Step):

Footspacing Dimension	Resolution
2 in	0.03 micron (1.0 microinch)
4 in	0.05 micron (2.0 microinch)
6 in	0.08 micron (3.0 microinch)

Table 1-2. Specifications and Supplemental Characteristics (Continued)

FLATNESS MEASUREMENTS (Continued)

Reference Plane Accuracy: The uncertainty of a surface plate flatness measurement is bounded by two parallel planes separated by the value below.

Metric Units Mode: $0.03\ M^2$ microns
English Units Mode: $0.12\ F^2$ microinches
where:
M = length of the surface diagonal in metres
F = length of the surface diagonal in feet

Lateral Offset and Flatness Range: The combination of lateral offset and maximum flatness deviation must not displace the Reflector more that ±1 mm from the beam path in any direction.

STRAIGHTNESS AND SQUARENESS MEASUREMENTS

The following specifications assume that the optional Dimensional Metrology Analysis System is used in conjunction with the HP 5528A to provide averaging and calculation capabilities for Straightness, Parallelism and Squareness measurements and that the Optical Square is aligned within 5 arc-min using autoreflection techniques.

Straightness Measurement Accuracy: Overall accuracy is the sum of the two components below.[1]

Overall Accuracy = Optical Reference Accuracy + Measurement Accuracy

Optical Reference Accuracy:[2]

Short Range Optics:
Metric Units Mode: $0.15\ M^2$ microns TIR
English Units Mode: $0.5\ F^2$ microinches TIR

Long Range Optics:
Metric Units Mode: $0.015\ M^2$ microns TIR
English Units Mode: $0.05\ F^2$ microinches TIR
where:
TIR = Total Indicated Reading
M = distance of travel of the moving optics in meters
F = distance of travel of the moving optic in feet

Measurement Accuracy:

Short Range Optics:

Temperature Range	Displayed Value	
	0–10 microns (0–400 microinches)	10–1500 microns (400–60000 microinches)
15–25° C	±3.5%	±1% ±0.25 microns (10 microinches)
0–40° C	±6%	±1% ±0.5 microns (20 microinches)

Long Range Optics:

Temperature Range	Displayed Value	
	0–100 microns (0–4000 microinches)	100–1500 microns (4000–60000 microinches)
15–25° C	±5%	±2.5% ±2.5 microns (100 microinches)
0–40° C	±7.5%	±2.5% ±5 microns (200 microinches)

Straightness Measurement Resolution:

Short Range Optics:
Metric Units Mode: 0.01 microns (0.00001 mm)
English Units Mode: 1 microinch

Long Range Optics:
Metric Units Mode: 0.1 microns (0.0001 mm)
English Units Mode: 10 microinches

Straightness Measurement Range: ± 1.5 mm (0.060 inch)

Axial Separation Range: (Typical with proper alignment, 15–25° C, distance between the Interferometer and the Reflector.)

Short Range Optics: 0.1–3 meters (4–120 inches)
Long Range Optics: 1–30 meters (3–100 feet)

Squareness Measurement Accuracy:

Short Range Optics:
Metric Units Mode: $(\pm 1.0' + 0.1M)$ arc-sec $\pm 1\%$ of θ
English Units Mode: $(\pm 1.0' + 0.03M)$ arc-sec $\pm 1\%$ of θ

Long Range Optics:
Metric Units Mode: $(\pm 1.0' + 0.01M)$ arc-sec $\pm 2.5\%$ of θ
Metric Units Mode: $(\pm 1.0' + 0.003M)$ arc-sec $\pm 2.5\%$ of θ
where:
θ = calculated out-of-squareness angle in arc-sec
M = distance of travel of the moving optic in meters
F = distance of travel of the moving optic in feet

NOTE

"1.0" can be as large as 1.2 arc-sec with maximum allowable misalignment of the optical square as per the alignment procedure.

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[1] This is analogous to the traditional straightedge and indicator method of measuring straightness, where Optical Reference Accuracy corresponds to the straightedge accuracy, and Measurement Accuracy corresponds to the indicator accuracy.

[2] Optical reference error can be eliminated by using straightedge (mirror) reversal techniques.

Table 1-2. Specifications and Supplemental Characteristics (Continued)

SYSTEM OPERATING CHARACTERISTICS

Velocity of Light (VOL Compensation)

Manual: Compensation factory is entered via keyboard. Range is 0.0 to 999.9 ppm.

Automatic: Requires 10751A/B Air Sensor. Displays of pressure, temperature, R.H. switch setting, and computed VOL are provided.

Material Expansion Coefficient: Entered via keyboard Range is -100 to +100 ppm per °C or °F.

Maximum Compensation Update Time: 2.5 seconds, typical.

Material Temperature:

Manual: Entered via keyboard. Range is 0-50°C or 32-122°F.

Automatic: Requires 1 to 3 10757A/B/C Material Temperature Sensors. Display of individual readings and average of all connected sensors is provided Average value is used in all calculations.

Display: 9½ digits with a - sign. Displayed resolution is selectable.

Preset Capability: Measurements can be preset to user selected values within the ranges shown below. Presets either add or multiply as indicated.

Measurement Type	Range in Metric Units Mode	Range in English Units Mode	Math Function
Distance	-50000 to +50000 mm	-2000 to +2000 in	Add
Velocity	-20000 to +20000 mm/min.	-720 to +720 in/min.	Add
Angle	0 to 2	0 to 2	Multiply
Straightness: Long Range or Short Range	0 to 3	0 to 3	Multiply

Direction Sense: Reverses sign of measurement direction. Does not change sign of preset value.

Units Selection: Rear panel switch selects Metric units (Millimeters, °C) or English units (inches, °F) for all displays and data entry.

Digital Output: Data is output in ASCII format via HP-IB (the Hewlett-Packard Interface Bus). Capabilities include: full TALKER, limited LISTENER, and no CONTROLLER. The following IEEE 488 Interface Function Codes are available: C0, T5, L4, SH1, AH1, SR1, RL1, PP0 DC1, and DT1. The maximum average output rate for each measurement type equals the Update Rate for that measurement type.

Update Rates: (Nominal) Measurement data are updated at the following average rates:

AVERAGE MEASUREMENT UPDATE RATES		
Measurement Type	Auto Record	HP-IB Triggered
Distance	20/s	20/s
Velocity	20/s	15/s
Angle	20/s	12/s
Straightness		
Not Max Resolution	20/s	25/s
Max Resolution	5/s	5/s

Auto Record: Outputs the value currently displayed at fixed intervals of time selected by the user. The range is 0.05 to 12.0 seconds in increments of 0.05 second, typical

Remote Record: Via Remote Control connector on rear panel of 5508A. TTL level (high to low) activates data output.

Remote Control Unit: Includes RESET and RECORD buttons and SIGNAL STRENGTH indicator for initiating data output from up to 15 meters away from the 5508A Measurement Display unit. Supplied with 5508A.

Data Smoothing: Smoothing (averaging) to reduce the effects of vibration and noise is automatically applied to all displayed measurement data. Smoothing can be turned off if desired.

1-19. 5528A LASER MEASUREMENT SYSTEM DESCRIPTION

1-20. The Hewlett-Packard Model 5528A Laser Measurement System (Figure 1-0) is a portable, lightweight dimensional measurement device capable of making single axis measurements including distance, velocity, angular, flatness, and straightness and squareness measurements. The system consists of the 5518A Laser Head, 5508A Measurement Display, several optical instruments, and the optional 10751A/B Air Sensor and 10757A/B/C Material Temperature Sensor.

1-21. EQUIPMENT DESCRIPTION

1-22. The following paragraphs describe the equipment and accessories supplied or available for the measurement system.

1-23. 5518A Laser Head

1-24. The 5518A Laser Head (Figure 1-1) is supplied with a Test Attenuator HP Part No. 1000-0598, a Test Polarizer HP Part No. 1000-0616, an Adjustment Screw HP Part No. 05518-20316, a Lock Nut HP Part No. 05518-20317, and 3 Screws M8 × 1.25 × 25 mm HP Part No. 0515-0798.

1-25. The 5518A Laser Head (Figure 1-1) consists of a thermally-tuned laser tube, control circuits, a reference receiver, a measurement receiver, and a high-voltage power supply. The tube provides a coherent collimated light source consisting of two orthogonally polarized frequency components. One component is polarized parallel to the plane of the mounting feet and the other is polarized perpendicular to that plane.

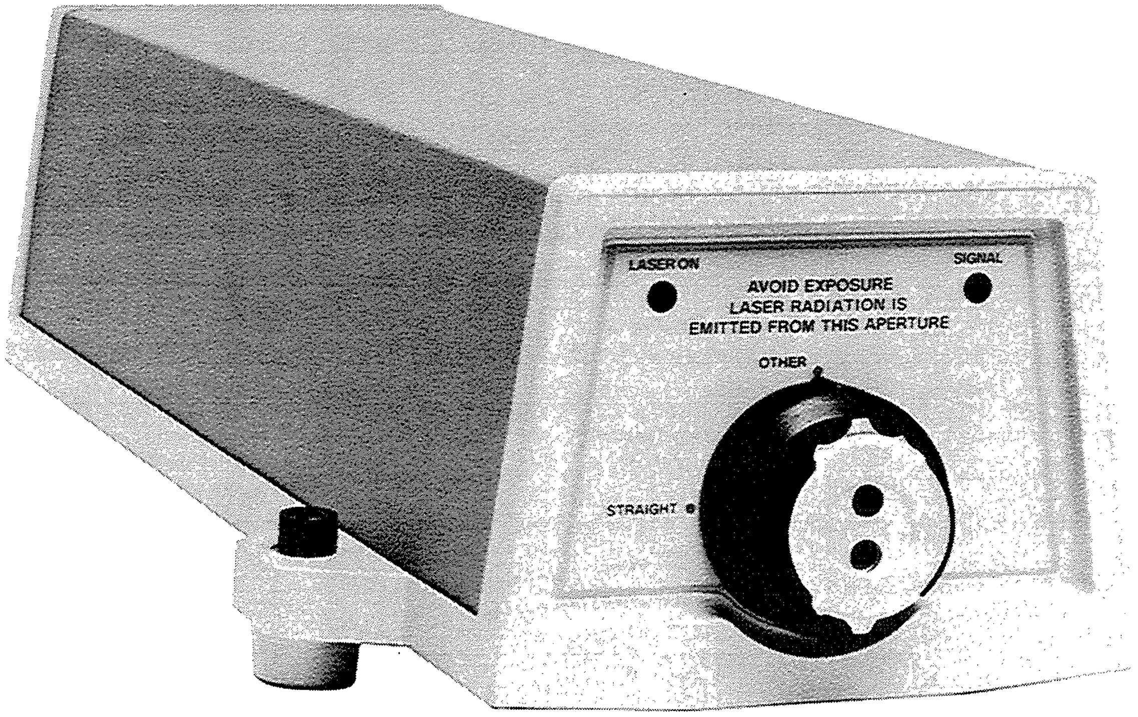

Figure 1-1. 5518A Laser Head

1-26. Before the laser beam is emitted from the Laser Head, a portion of it is sampled. Most of this sample is fed into the reference receiver to determine the difference in frequency between the two optical components. This difference frequency is called the **Reference Frequency**. The remainder of the sampled beam is used to control the tuning of the laser.

1-27. During a measurement, the laser beam is directed through measurement optics and then returned to the measurement receiver to determine the measurement difference frequency. If the optics remain stationary the **Measurement Frequency** and the **Reference Frequency** are the same. Relative motion between the measurement optics results in a change of the **Measurement Frequency**. The 5508A compares the measurement frequency to the reference frequency and calculates the displacement of the optics.

1-28. 5508A Measurement Display

1-29. The 5508A Measurement Display (Figure 1-2) is supplied with Remote Control Unit 05508-60021.

1-30. The Measurement Display (Figure 1-2) consists of measurement and reference pulse counters, analog-to-digital converter circuits, HP-IB circuits, a data bus system, keyboard-display, processor, and power supplies. An extensive self-test feature is built into the 5508A which runs immediately after power-up, thereby giving a high degree of confidence that the equipment is operating properly.

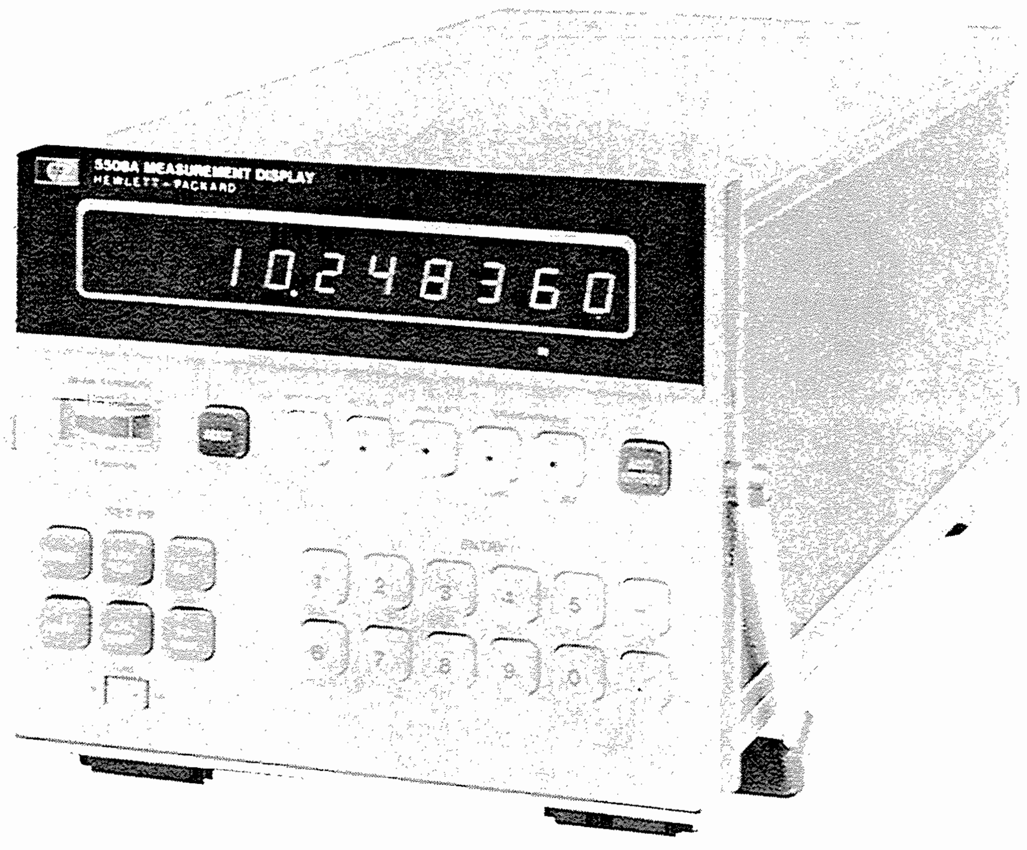

Figure 1-2. 5508A Measurement Display

1-31. The major function of the Measurement Display is to continuously subtract the reference counter contents from the measurement counter contents and display the difference. The 5508A can also correct the difference count by first multiplying the difference count value by a compensation factor.

1-32. The compensation factor is used to correct for the dependence of laser wavelength on air temperature, pressure and humidity. It is also used to correct for thermal expansion of the material being measured. The compensation factor can be determined by the user and entered into the 5508A via the front panel or can be calculated automatically by the 5508A if the optional 10751A/B Air Sensor and/or 10757A/B/C Material Temperature Sensors are used.

1-33. The keyboard on the Measurement Display unit allows the operator to select operating modes and displays, enter data, and has provision for reset and record functions.

1-34. The HP-IB circuits allow the Laser Display to be interfaced with an external controller such as a calculator or computer. Data may be either input or output via the bus. The HP-IB also allows all front panel keyboard functions to be remotely programmed via HP-IB. A "talk only" mode allows transfer of data to a recording device without using an HP-IB controller. The Hewlett-Packard Interface Bus (HP-IB) is HP's implementation of the ANSI/IEEE-488 Standard Interface.

1-35. 05508-60021 Remote Control Unit

1-36. The Remote Control Unit (Figure 1-3) is supplied with the 5508A and allows the Measurement Display to be reset from a remote location. Operation of the Laser Head is unaffected by the reset function. Provision is also made to remotely select the record function to output data to calculators, plotters, and monitors. A beam strength meter is included in the remote control unit.

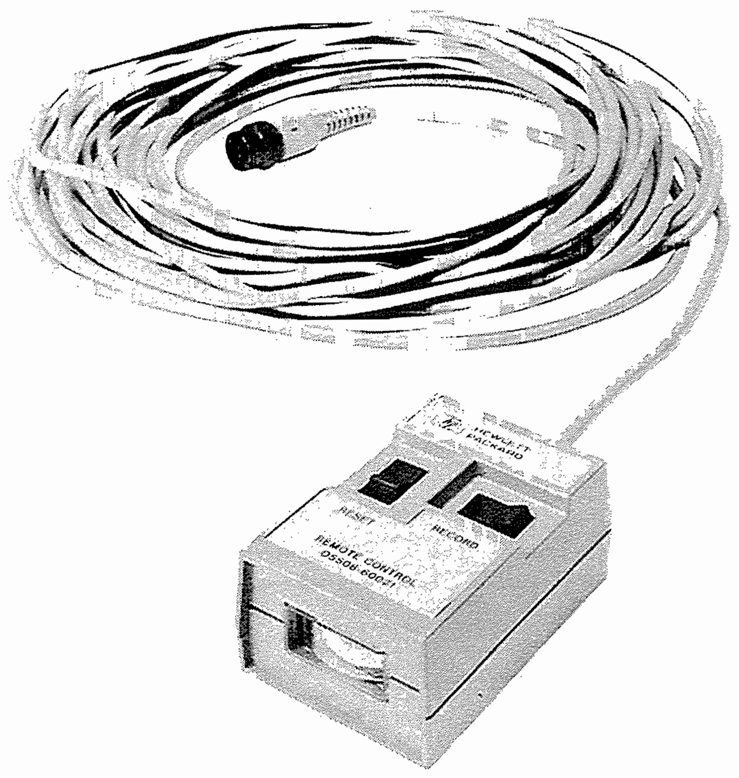

Figure 1-3. Remote Control Unit

1-37. 10751A/B Air Sensor

1-38. The 10751A/B (Figure 1-4) measures air temperature and pressure, and has provision for manually setting in a factor for low, mid, or high humidity. The sensor output connects to an analog-to-digital converter in the Measurement Display. The difference between the A and B models is the cable length, the 10751A cable length is 5 metres (16 feet), and the 10751B cable is 15 metres (49 feet).

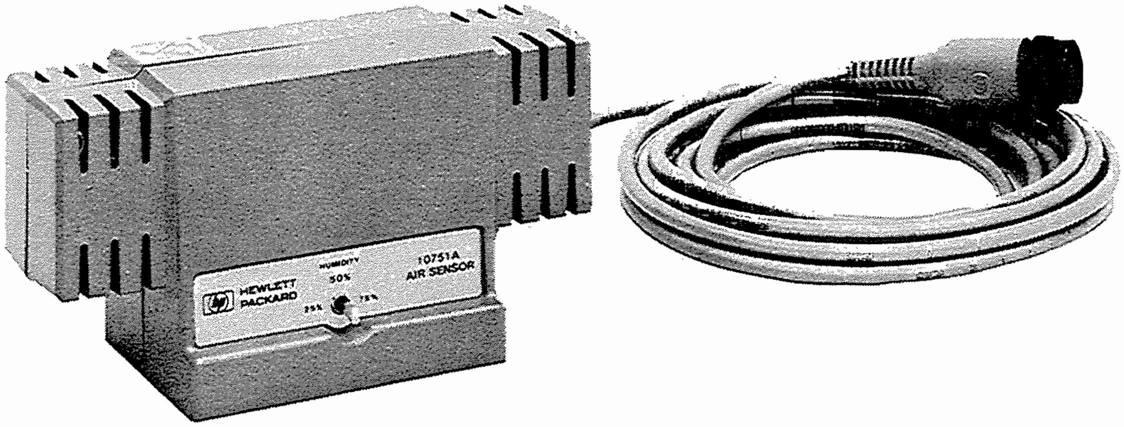

Figure 1-4. 10751A/B Air Sensor

1-39. 10757A/B/C Material Temperature Sensors

1-40. Up to three 10757A/B/C Material Temperature Sensors (Figure 1-5) can be used to sense the temperature of the workpiece. The Measurement Display has provision to enter the workpiece coefficient of expansion from the keyboard. Material temperature and the coefficient of expansion are used in computing the total compensation factor used for computations. The difference in the A, B, and C models is the cable length, the 10757A cable length is 5 metres (16 feet), the 10757B cable length is 15 metres (49 feet), the 10757C cable length is 25 metres (82 feet).

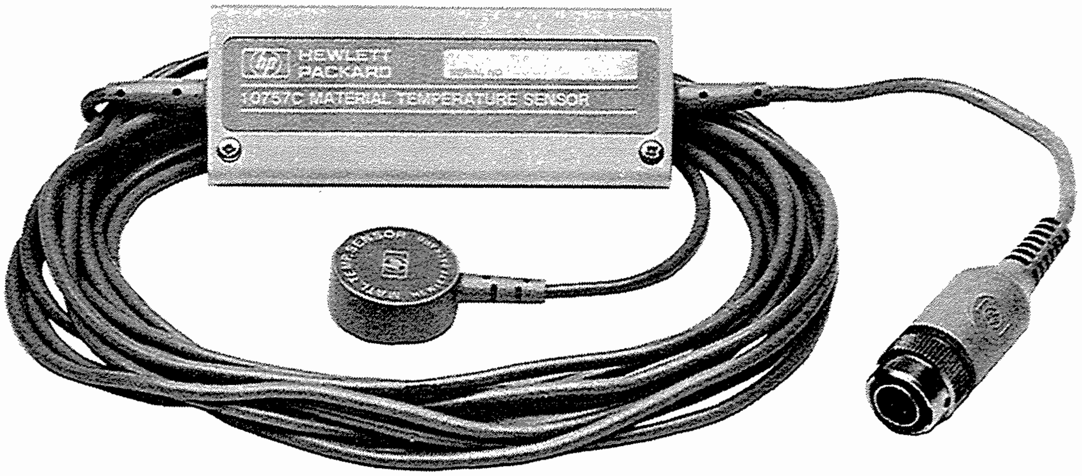

Figure 1-5. 10757A/B/C Material Temperature Sensor

1-41. 10753A Tripod

1-42. The optical instruments used in the system can be remotely located from the Laser Head for greater accuracy and convenient fixturing. By locating the Laser Head away from the measurement setup, a potential source of heat is eliminated.

1-43. The Model 10753A (Figure 1-6) is especially designed for this purpose, allowing rapid alignment and easier setups. It is equipped with a heavy duty mounting plate and can be adjusted for tilt, height, rotation, and lateral movement. The tripod is collapsible and portable. The tripod consists of a Mounting Plate, HP Part No. 10753-60001, a Cross Slide Assembly, HP Part No. 1000-0387, a Column Adapter, HP Part No. 1531-0052, and a Tripod Assembly, HP Part No. 1530-2169.

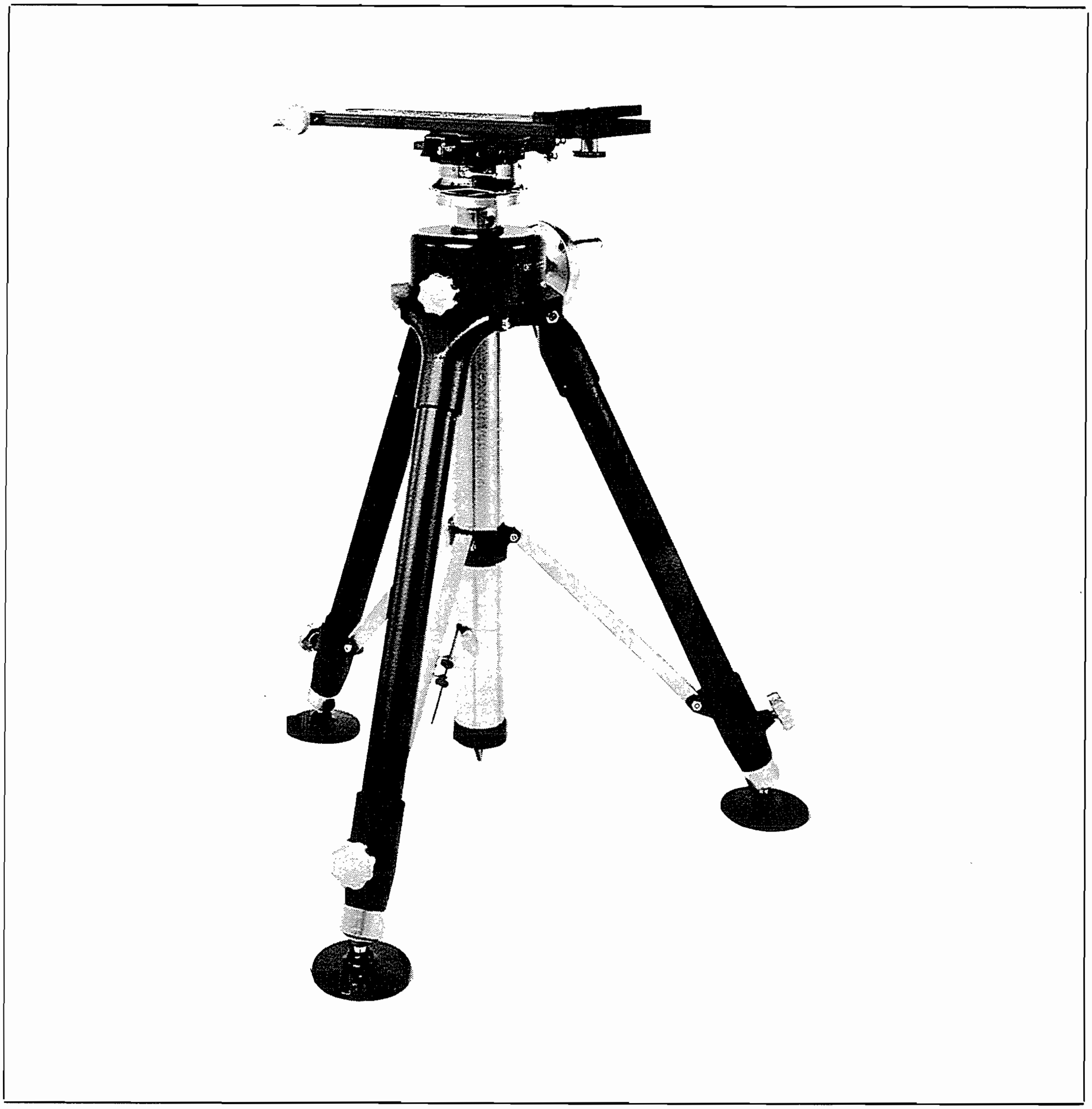

Figure 1-6. 10753A Tripod

1-44. 10759A Footspacing Kit

1-45. The footspacing kit (Figure 1-7) consists of:

1 each, Footspacer, 101.6 mm; HP Part No. 10759-20001
1 each, Footspacer, 152.2 mm; HP Part No. 10759-20002
1 each, Footspacer, 50.8 mm; HP Part No. 10759-20003
6 each, Hex Head Screws, M3 × 8L; HP Part No. 0515-0348
1 each, Hex Wrench, size 2.5 mm; HP Part No. 8710-1181

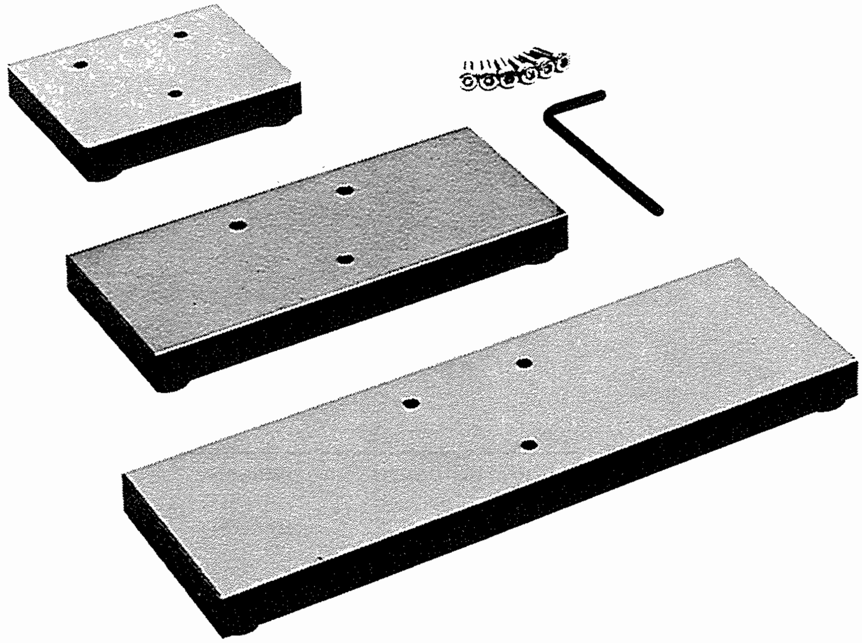

Figure 1-7. 10759A Footspacing Kit

1-46. The footspacing kit is used with the 10770A Angular Interferometer and the 10771A Angular Reflector to minimize grid setup time and data accumulation time required in checking the flatness of a surface plate. Each foot has three carbide pads to minimize wear.

1-47. 10766A Linear Interferometer

1-48. This interferometer (Figure 1-8) is a passive optical device designed to separate the two frequency components of the 5518A laser beam. The components are recombined by the interferometer after being reflected from their respective optical paths. The two optical paths determined by the interferometer are at right angles to each other. For this reason, linear displacement can be measured parallel or perpendicular to the 5518A laser beam output. The 10766A is supplied with a package of Lens Tissue, HP Part No. 9281-0363.

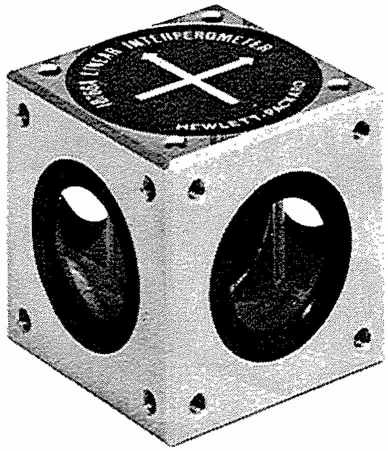

Figure 1-8. 10766A Linear Interferometer

1-49. 10767A Linear Retroreflector

1-50. The retroreflector (Figure 1-9) is used to return the laser beam components to the 10766A Linear Interferometer. It contains a cube corner which has the property that an incident laser beam is reflected parallel to the incoming beam within seconds of arc. The 10767A is supplied with 2 captive screws, HP Part No. 10767-20004, a package of Lens Tissue, HP Part No. 9281-0363, and Alignment Target, HP Part No. 10767-67001.

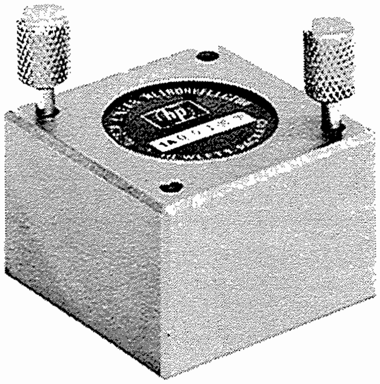

Figure 1-9. 10767A Linear Retroreflector

1-51. 10770A Angular Interferometer

1-52. The angular interferometer (Figure 1-0) provides the capability of making pitch and yaw measurements as well as flatness with the 5528A system. Two beams exit the 10770A spaced to be compatible with the 10771A Angular Reflector. Rotation of either the 10770A or 10771A results in differential path changes which are interpreted by the 5508A as angular displacement. The 10770A is supplied with a package of Lens Tissue, HP Part No. 9281-0363, and Alignment Target, HP Part Number 10767-67001.

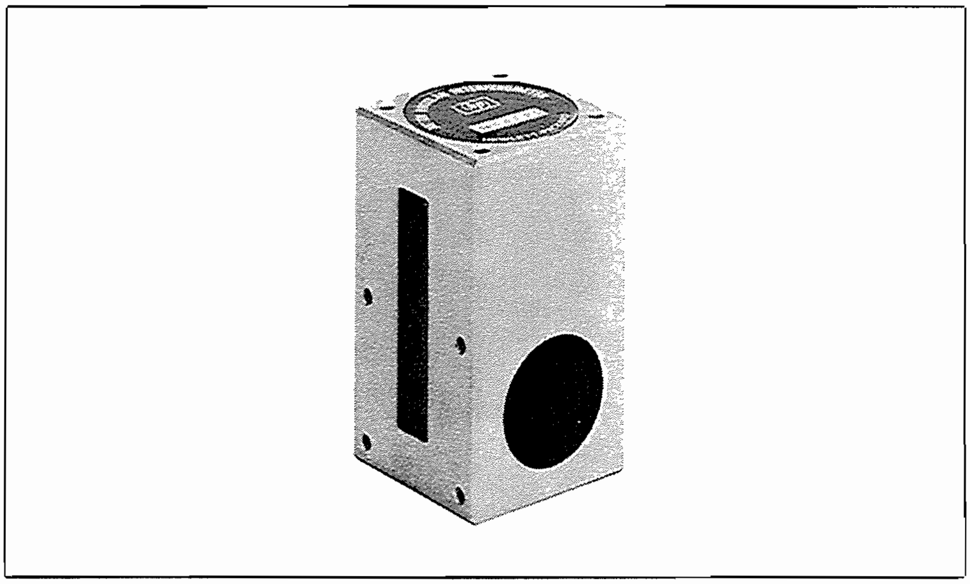

Figure 1-10. 10770A Angular Interferometer

1-53. 10771A Angular Reflector

1-54. The angular reflector (Figure 1-11) is used with the 10770A Angular Interferometer. It consists of two retroreflectors whose center to center spacing is carefully controlled to coincide with the two beams from the 10770A interferometer. Rotation of the 10771A or 10770A results in differential path changes which are interpreted by the 5508A as angular displacement. The 10771A is supplied with a package of Lens Tissue, HP Part No. 9281-0363, and Alignment Target, HP Part No. 10767-67001.

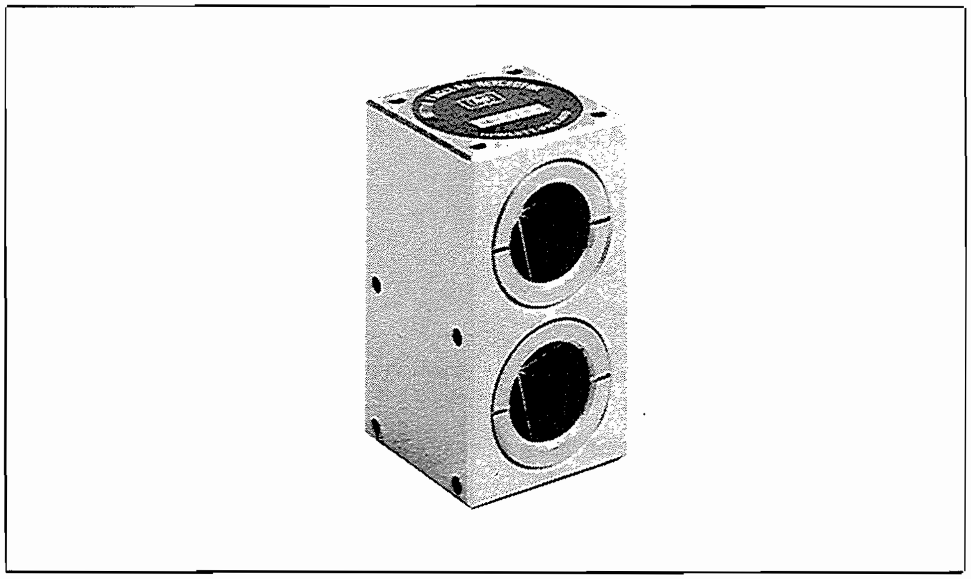

Figure 1-11. 10771A Angular Reflector

1-55. 10772A Turning Mirror

1-56. The 10772A consists of:

1 each, Turning Mirror; HP Part No. 10772-67002
1 each, Leveling Plate; HP Part No. 10772-67001
1 each, Mounting Screw; HP Part No. 10772-67003

1-57. The turning mirror is a high quality front surface mirror housed in a mount that is compatible with the other optics. The 10772A is supplied with a package of Lens Tissue HP Part No. 9281-0363.

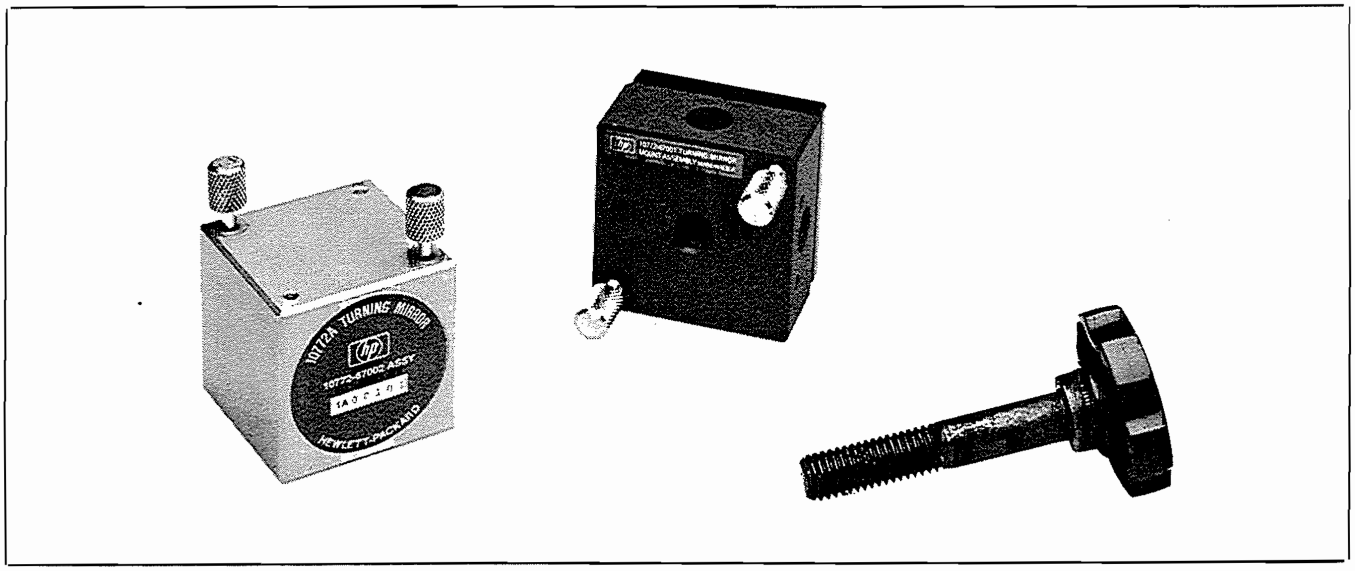
10772A TURNING MIRROR
hp
10772-67002 ASSY
HEWLETT-PACKARD

Figure 1-12. 10772A Turning Mirror

1-58. 10773A Flatness Mirror

1-59. The flatness mirror (Figure 1-13) consists of the mirror, eight hex screws M3 × 8L (HP Part No. 0515-0348), and a 2.5 mm hex wrench (HP Part No. 8710-1181). The Flatness Mirrors are used for convenience in surface plate calibration applications.

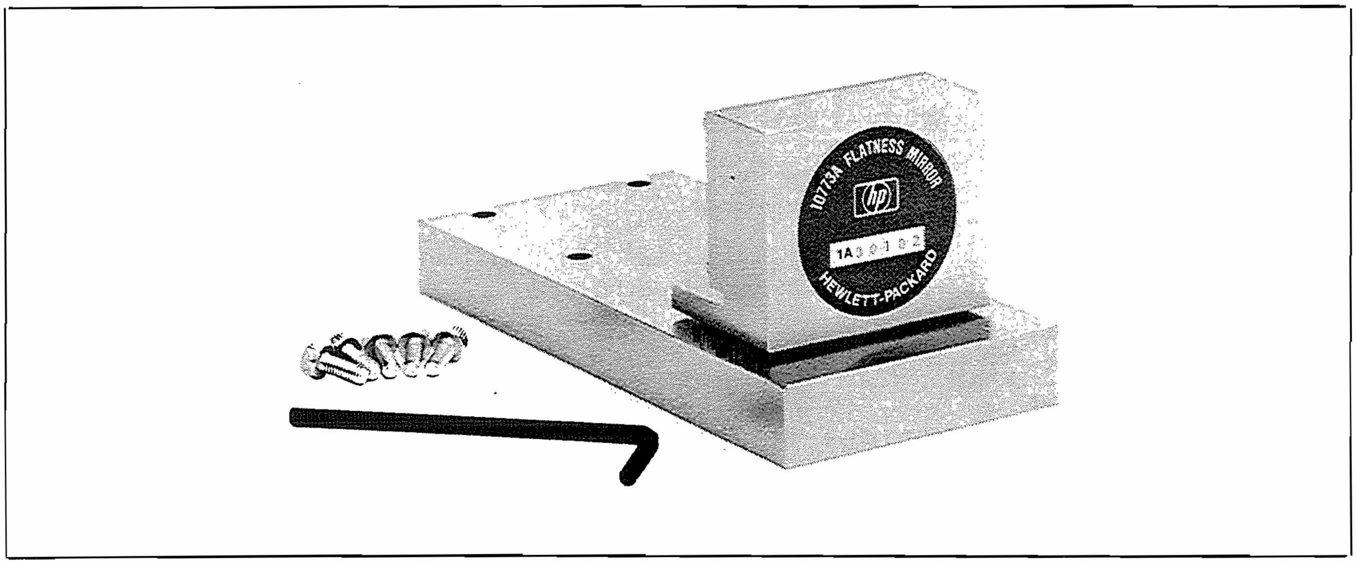
10773A FLATNESS MIRROR
hp
HEWLETT-PACKARD

Figure 1-13. 10773A Flatness Mirror

1-60. 10774A Short Range Straightness Optics

1-61. The 10774A (Figure 1-14) permits straightness measurements over the range of 100 mm to 3000 mm (4 in to 120 in). The interferometer consists of 2 parts, a rotatable prism and a reflector containing 2 mirrors. The straightness interferometer measures lateral displacement between the prism assembly and the reflector assembly. The prism and reflectors are shipped as matched optical sets that are accurately calibrated to each other. They should never be used separately with other similar components. Displacement is measured in a line parallel to the long axis of the straightness reflector and perpendicular to the laser beam. Displacement range is ±1.5 mm (±0.1 in). The 10774A is supplied with a package of Lens Tissue, HP Part No. 9281-0363, and Alignment Target, HP Part No. 10774-67001.

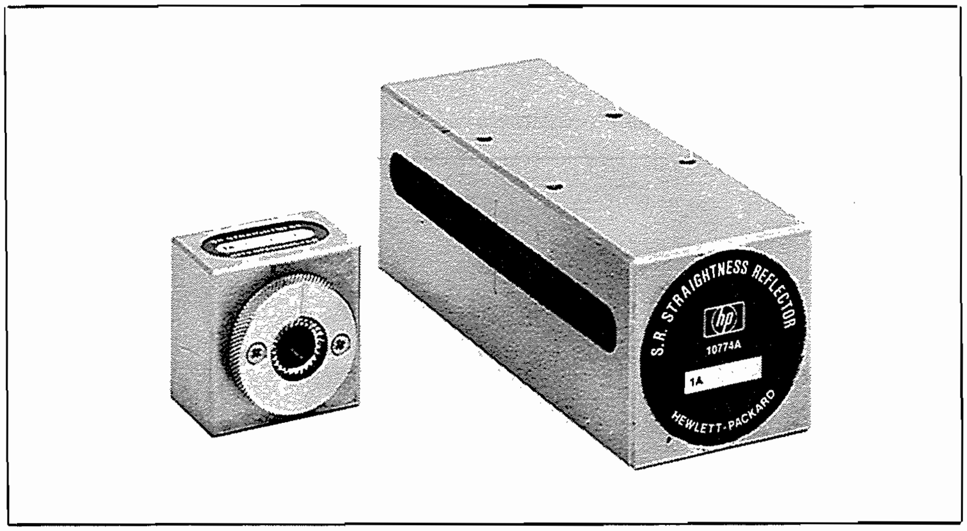

Figure 1-14. 10774A Short Range Straightness Optics

1-62. 10775A Long Range Straightness Optics

1-63. The 10775A (Figure 1-15) permits straightness measurements over the range of 1000 mm to 30,000 mm (40 in to 1200 in). The interferometer is similar to the 10774A. Optics changes have been made to give longer range traded off for less resolution. The prism and reflectors are shipped as matched optical sets that are accurately calibrated to each other. They should never be used separately with other similar components. The 10775A is supplied with a package of Lens Tissue, HP Part No. 9281-0363, and Alignment Target, HP Part No. 10774-67001.

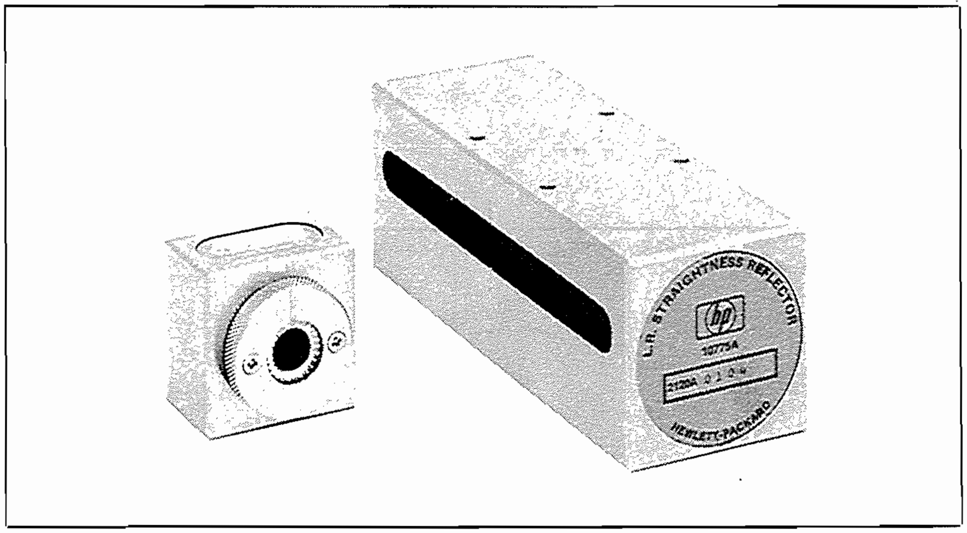

Figure 1-15. 10775A Long Range Straightness Optics

1-64. 10776A Straightness Accessory Kit

1-65. 10776A Straightness Accessory Kit consists of:

1 each, Base Assembly; HP Part No. 10776-67003
1 each, Straightness Retroreflector; HP Part No. 10776-67001
1 each, Reflector Mount; HP Part No. 10776-67002
1 each, Adapter Plate; HP Part No. 10776-20001
1 each, Post; HP Part No. 10776-20008
2 each, Post; HP Part No. 10785-20005
4 each, Screw Machine, M3 × 0.005 × 16 mm; HP Part No. 0515-0078
4 each, Screw Socket Head, M3 × 0.05 × 8 mm; HP Part No. 0515-0348
1 each, Hex Wrench, HP Part No. 8710-1181

1-66. These mounts simplify straightness measurement setups.

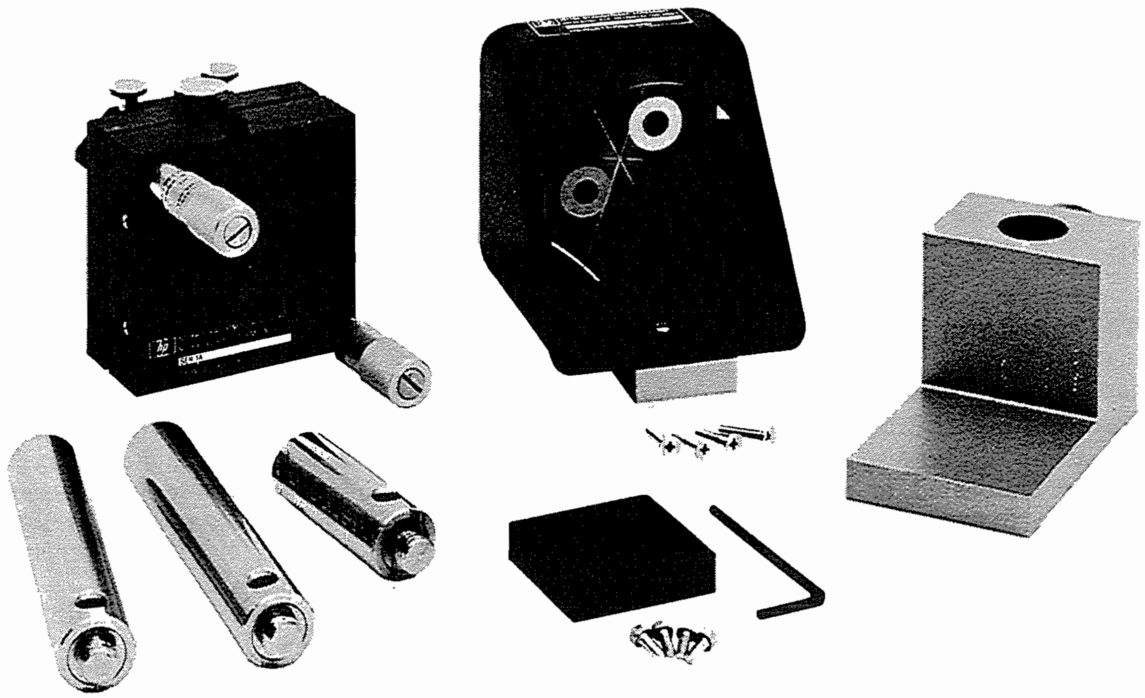

Figure 1-16. 10776A Straightness Accessory Kit

1-67. 10777A Optical Square

1-68. The optical square (Figure 1-17) consists of the optical square, a mount, and a gage block, HP Part Number 8750-0360. The square bends an optical path at a defined 90° angle. It is used to establish a right angle reference for measurements of squareness between two machine tool axes using the system straightness optics. In addition, it can be used with many other optics for calibration measurements.

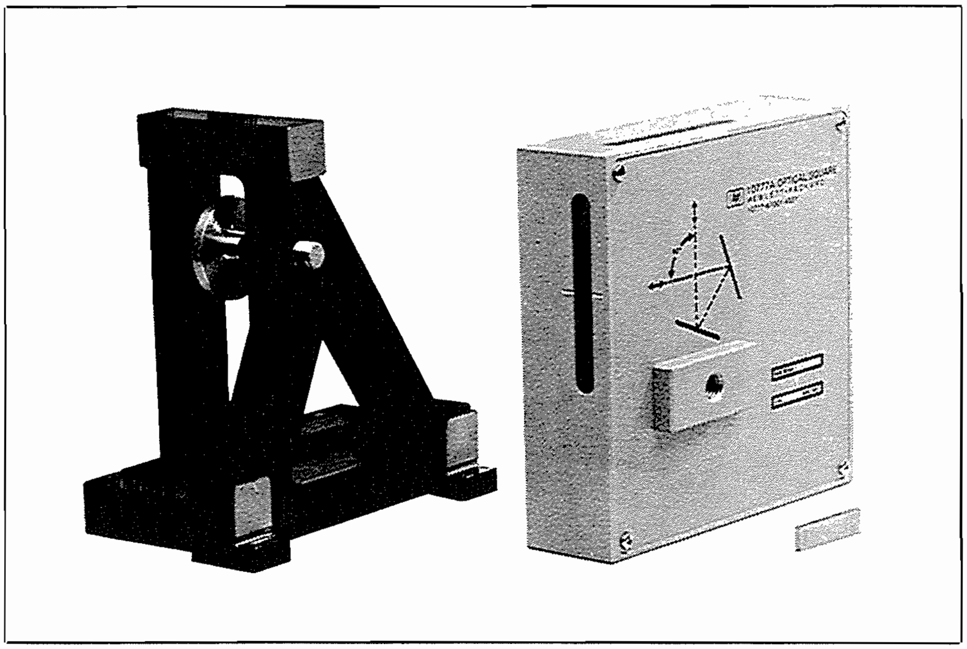

Figure 1-17. 10777A Optical Square

1-69. 10784A Base

1-70. Figure 1-18 shows the base used for clamping optics to machine surfaces. The optics mount to the 10785A Height Adjuster which is fixed to the base through the post.

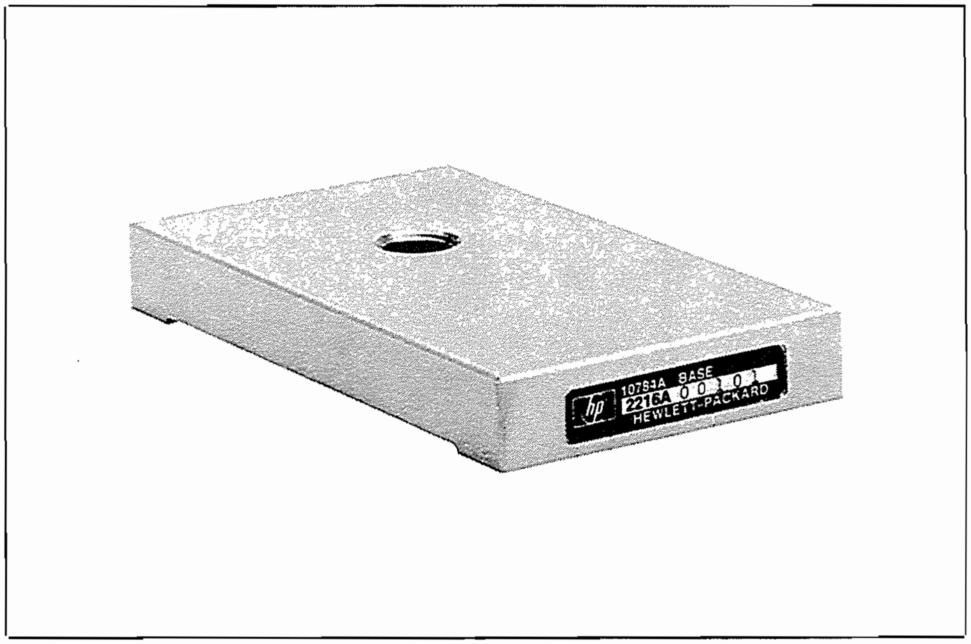

Figure 1-18. 10784A Base

1-71. 10785A Height Adjuster and Post

1-72. The 10785A Height Adjuster and Post (HP Part No. 10785-20005) can accommodate linear and angular optics as well as the small leveling plate. The 10785A (Figure 1-19) provides a convenient adjustment for optical alignment. The 10785A is supplied with 2 captive screws, HP Part No. 10785-20002.

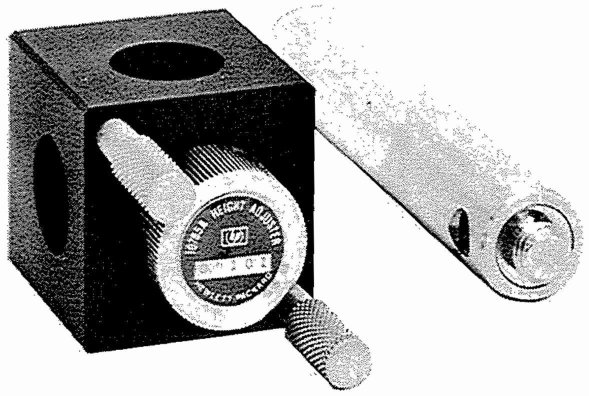

Figure 1-19. 10785A Height Adjuster and Post

1-73. OPTICAL KITS

1-74. The optics are available in kits designed to provide the necessary equipment to perform particular types of measurements. Kits are available for linear measurements, angular optics, flatness accessory, and straightness measurements.

1-75. 55280A Linear Measurement Kit

1-76. This kit consists of the following equipment:

1 each, 10766A Interferometer
2 each, 10767A Linear Retroreflector
2 each, 10784A Base
3 each, 10785A Height Adjuster and Post
1 each, 10786A Linear Angular Carrying Case

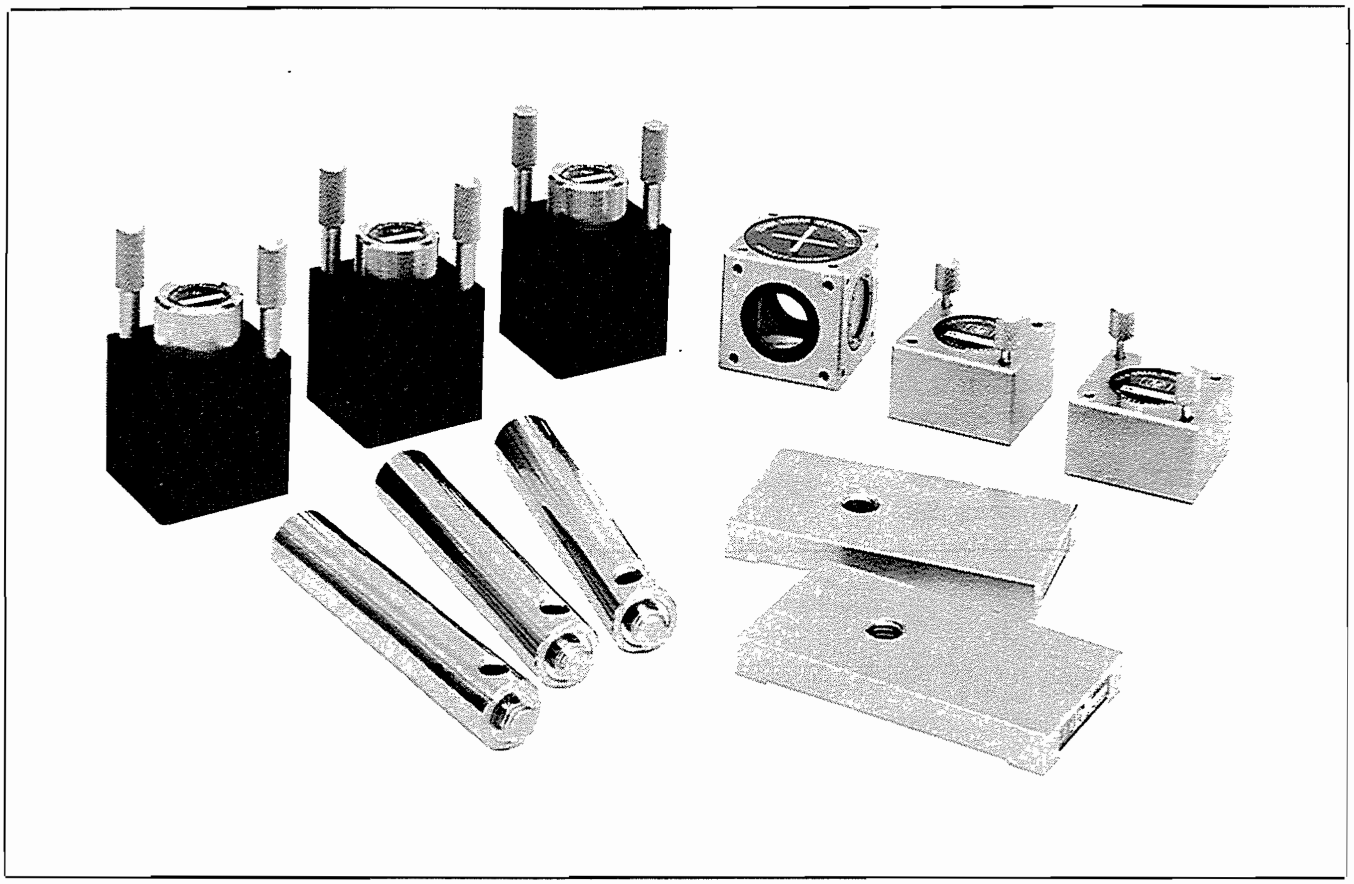

Figure 1-20. 55280A Linear Measurement Kit

1-77. 55281A Angular Optics

1-78. This kit contains the following equipment:

1 each, 10770A Angular Interferometer
1 each, 10771A Angular Reflector

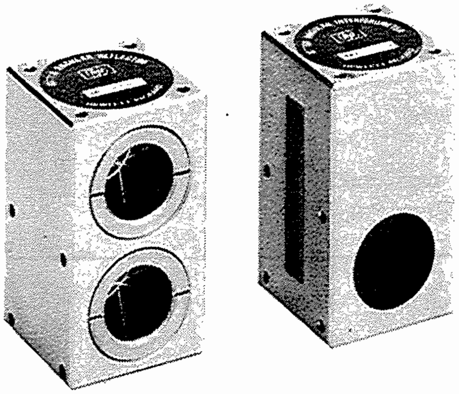

Figure 1-21. 55281A Angular Optics

1-79. 55282A Flatness Accessory Kit

1-80. This kit requires the use of the 55281A Angular Optics to make flatness measurements. The flatness mirror can be rotated 360° on its base while maintaining a very accurate perpendicular alignment to the mounting surface. The flatness accessory kit consists of the following equipment:

2 each, 10773A Flatness Mirror
1 each, 10759A Footspacing Kit

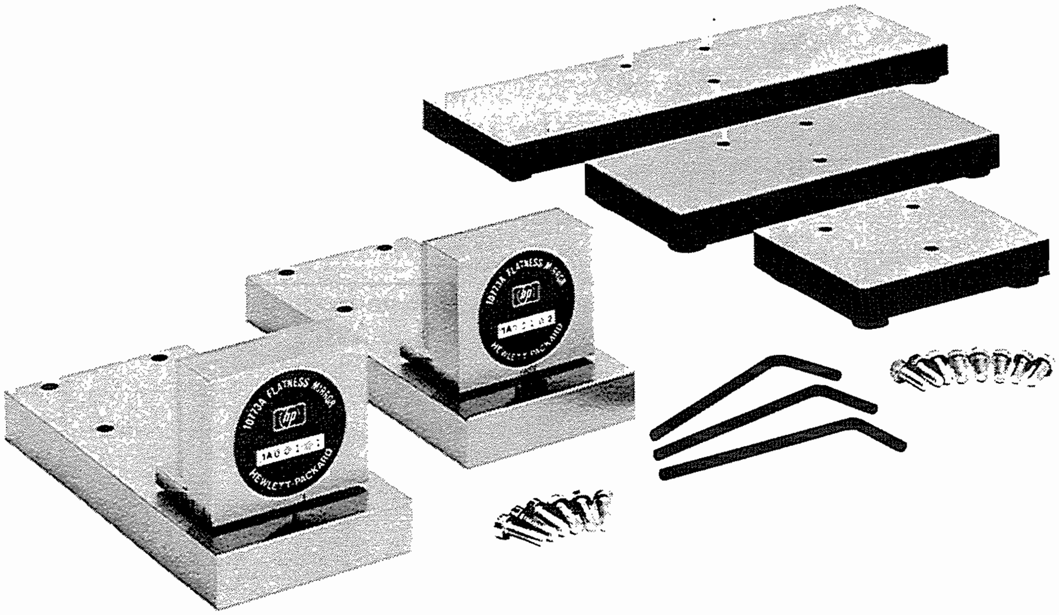

Figure 1-22. 55282A Flatness Accessory Kit

1-81. 55283A Straightness Measurement Kit

1-82. This kit includes the following equipment:

1 each, 10772A Turning Mirror
1 each, 10774A Short Range Straightness Optics
1 each, 10776A Straightness Accessory Kit
1 each, 10787A Straightness/Squareness Carrying Case

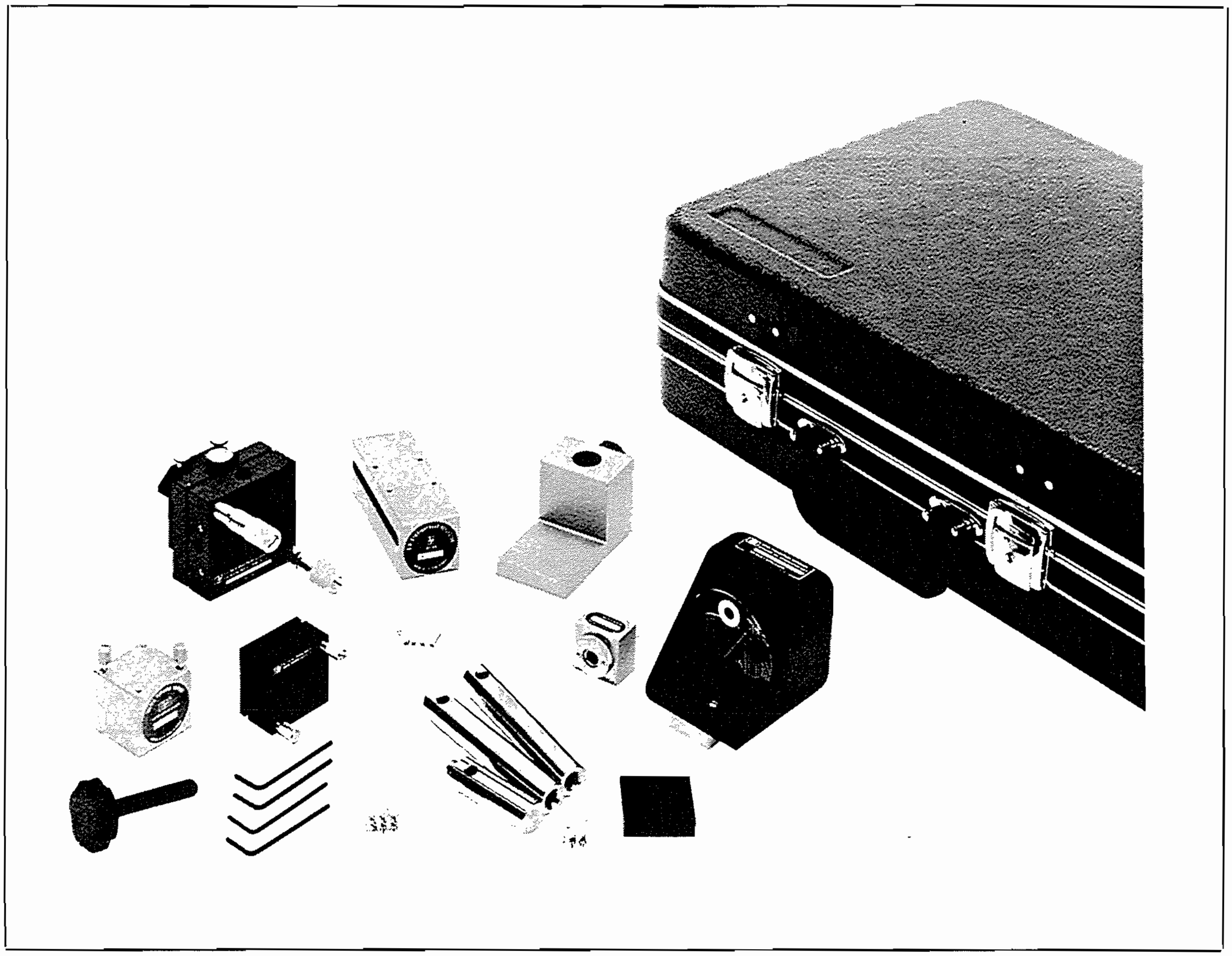

Figure 1-23. *55283A Straightness Measurement Kit*

1-83. OTHER COMPATIBLE EQUIPMENT

1-84. Since the 5528A has HP-IB capability, the system may be used with other HP-IB equipment such as calculators and recorders.

1-85. SYSTEM CONFIGURATIONS

1-86. System configurations include linear, angular, flatness, straightness-short range, straightness-long range and squareness. Suggested configurations are shown in Table 1-3.

Table 1-3. Suggested System Configurations

	Linear	Angular	Flatness	Short Range Straightness	Long Range Straightness	Squareness
5518A	1	1	1	1	1	1
5508A	1	1	1	1	1	1
10753A	1	1	1	1	1	1
55280A	1	1				
55281A		1	1			
55282A			1			
55283A				1	1	1
10775A					1	
10777A						1
10751A/B	1					
10757A/B/C	1, 2, 3					
55288A	1	1	1	1	1	1

1-87. RECOMMENDED TEST EQUIPMENT

1-88. Equipment required to maintain the Laser Measurement System is listed in Table 1-4. Other equipment may be substituted if it meets or exceeds the critical specifications listed in the table.

Table 1-4. Recommended Test Equipment

Instrument	Use *	Specifications	Recommended Equipment (Equipment Having Equivalent Characteristics May be Substituted)
For 5508A, 5518A, 10751A/B, 10757A/B/C			
Signature Multimeter	T	Detect TTL and ECL level signals	HP 5006A
Oscilloscope	T	100 MHz Bandwidth	No Recommendation
Laser Power Meter	T	Range: 1 microwatt to 1 milliwatt Accuracy: ±10%	Graseby Optronics, Model 351L (Phone 407-282-1408)
High Voltage Probe	T	Capable of handling 15K Vdc	HP 34111A
Milliammeter	T,A	10 mA range Accuracy: ±0.1 mA	HP 428B
Neutral Density Filter	A	31.6% Transmission	Oriel Manufacturing Model 5034
Logic Pulser	T	TTL	HP 546A
Current Tracer	T	Sensitivity: 1 mA to 1 amp	HP 547A
Logic Clip	T	TTL Compatible 16-pin IC mounting	HP 548A
Logic Probe	T	TTL/CMOS Capability with Pulse Memory	HP 545A
Digital Voltmeter	T,C	DC Volts: Floating Inputs Input Resistance: 10^{10} Ω 10V Range Accuracy: ±250 microvolts 1V Range Accuracy: ± 52 microvolts	HP 3456A
THE FOLLOWING EQUIPMENT IS USED FOR CALIBRATING THE 10751A/B AND 10757A/B/C. THIS EQUIPMENT WILL NOT BE NECESSARY IF THE 10751A/B AND 10757A/B/C ARE RETURNED TO HEWLETT-PACKARD FOR PERIODIC CALIBRATION.			
Quartz Thermometer or Glass Thermometer with Probe	51, 57	Range: 0°C - 40°C Accuracy: ±0.04°C	HP 2804A and HP 18120A Laboratory Probe calibrated within past 3 months
Temperature Bath	51, 57	Volume: 15 Liters Uniformity: ±0.01°C	Benco Grant Model SP15
Refrigeration Unit for Temperature Bath	51, 57		Benco Grant Model CC-15
Dielectric Liquid for Temperature	51, 57		Flourinet FC-40 3M Company
Precision Pressure Controller	51	Range: 22 - 31 in Hg (minimum) (558.8 - 787.4 mm Hg) Accuracy: ±0.0125% of reading	Texas Instruments Model 156-02
Calibration Accessories Kit	51, 57	Extender Cables and Adapter	HP Model K16-59995A

** P = Performance Test; C = Calibration; A = Adjustments T = Troubleshooting*
51 = 10751A/B Calibration 57 = 10757A/B/C Calibration

1-89. WARRANTY

1-90. The warranty statement for the instrument including the laser tube is located on the inside cover of this manual.

SECTION II
INSTALLATION

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SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section provides installation instructions for the Model 5528A Laser Measurement System. This section also includes information about initial inspection and damage claims, preparation for use, packaging, and storage.

2-3. INITIAL INSPECTION

WARNING

TO AVOID HAZARDOUS ELECTRICAL SHOCK, DO NOT PERFORM ELECTRICAL TESTS WHEN THERE ARE SIGNS OF SHIPPING DAMAGE TO ANY PORTION OF THE OUTER ENCLOSURE (COVERS, PANELS, METERS).

2-4. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. Procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the system or some component fails the performance tests, notify the nearest Hewlett-Packard Office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection. The HP office will arrange for repair or replacement at HP's option without waiting for a claim settlement.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. The HP 5528A Measurement System draws all of its required power from the 5508A Measurement Display. The 5508A draws a maximum of 175 VA from the primary mains and may be connected to the following 48 to 66 Hertz sources:

100 Volts +5, -10%
120 Volts +5, -10%
220 Volts +5, -10%
240 Volts +5, -10%

⚠ 2-8. Line Voltage and Fuse Selection

CAUTION

Before connecting the instrument to ac power lines, be sure that the voltage selector is properly positioned as described below.

2-9. The line voltage is selected by means of a printed circuit located in the power line module on the rear panel of the 5508A. To check or change the line voltage selection, proceed as follows:

a. On the 5508A, disconnect the power cable from the power line module.

b. Slide the clear plastic window to the left. Pull the small lever marked FUSE PULL outward from the power line module. Remove the fuse and note its value.

c. Using a pair of long nose pliers, pull the pc card out of the power line module.

d. The pc card is marked in such a manner that only one line voltage selection will read right side up in a particular orientation as shown in Figure 2-1 below.

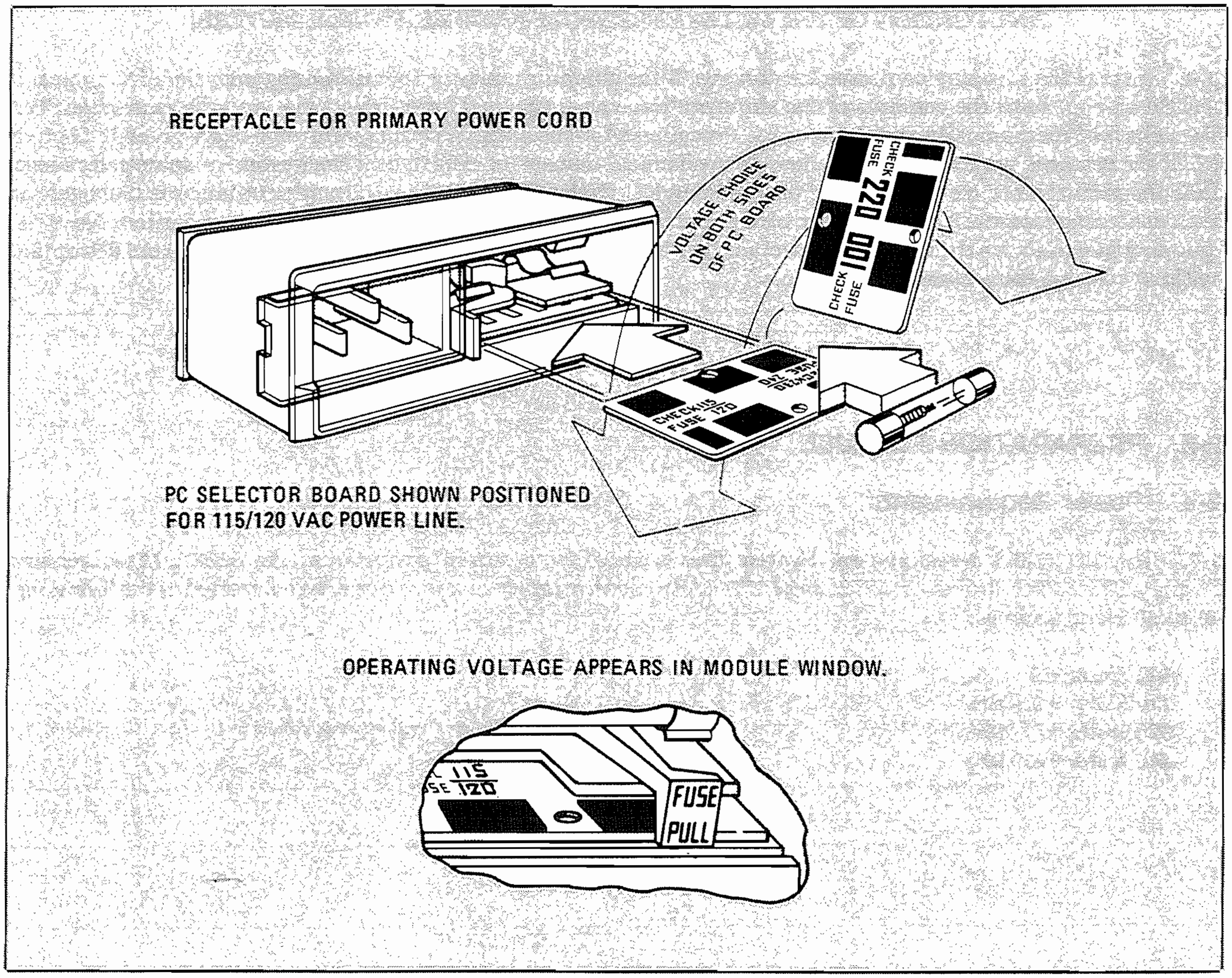

RECEPTACLE FOR PRIMARY POWER CORD
VOLTAGE CHOICE ON BOTH SIDES OF PC BOARD
CHECK FUSE 220
100 CHECK FUSE
CHECK 115 FUSE 120
PC SELECTOR BOARD SHOWN POSITIONED FOR 115/120 VAC POWER LINE.
OPERATING VOLTAGE APPEARS IN MODULE WINDOW.
115 120
FUSE PULL

Figure 2-1. Line Voltage Selection

e. Orient the pc card until the desired voltage selection is right side up (Figure 2-1 is oriented for a 115/120 volt line selection).

f. Insert the pc card into the line module.

g. Push the FUSE PULL lever into the power line module before installing the fuse.

h. Insert the proper size fuse (marked on the rear panel) for the line voltage selected. Orient the fuse parallel to and near the top of the power module and push into place. Fuse values and part numbers are as follows:

100 to 120 Volt Lines — 2 Amp 250V Fast Blo Fuse, HP P/N 2110-0002

198 to 240 Volt Lines — 1 Amp 250V Fast Blo Fuse, HP P/N 2110-0001

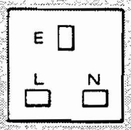
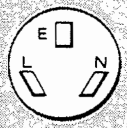
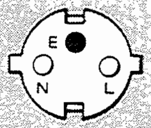
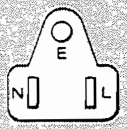
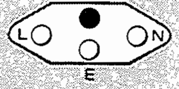
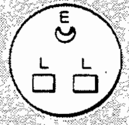
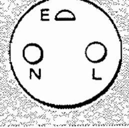
i. Slide the plastic window to the right side of the power module.

⚠ 2-10. Power Cable

WARNING

BEFORE SWITCHING ON THIS INSTRUMENT, THE PROTECTIVE EARTH TERMINAL OF THIS INSTRUMENT MUST BE CONNECTED TO THE PROTECTIVE CONDUCTOR OF THE (MAINS) POWER CORD. THE MAINS PLUG SHALL BE INSERTED ONLY IN A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD (POWER CABLE) WITHOUT A PROTECTIVE EARTH CONDUCTOR.

2-11. The 5508A is shipped with a three-wire power cable. When the cable is connected to an appropriate ac power source, this cable connects the chassis to earth ground. The type of power cable shipped with each instrument depends on the country of destination. Refer to Figure 2-2 for the part numbers of the power cable and plug configurations available.

PLUG TYPE	CABLE HP PART NO.	*CD	PLUG DESCRIPTION	CABLE LENGTH (INCHES)	CABLE COLOR	FOR USE IN COUNTRY
250V 	8120-1351	0	Straight **BS1363A	90	Mint Gray	United Kingdom, Cyprus, Nigeria Rhodesia, Singapore
	8120-1703	6	90°	90	Mint Gray	
250V 	8120-1369	0	Straight **NZSS198/ASC112	79	Gray	Austrailia, New Zealand
	8120-0696	4	90°	87	Gray	
250V 	8120-1689	7	Straight **CEE7-Y11	79	Mint Gray	East and West Europe, Saudi Arabia, Egypt, So Africa, India (Unpolarized in many nations)
	8120-1692	2	90°	79	Mint Gray	
125V 	8120-1348	5	Straight **NEMA5-15P	80	Black	United States, Canada, Japan (100V or 200V), Mexico, Philippines, Taiwan
	8120-1398	5	90°	80	Black	
	8120-1754	7	Straight **NEMA5-15P	36	Black	
	8120-1378	1	Straight **NEMA5-15P	80	Jade Gray	
	8120-1521	6	90°	80	Jade Gray	
	8120-1676	2	Straight **NEMA5-15P	30	Jade Gray	
250V 	8120-2104	3	Straight **SEV1011 1959-24507 Type 12	79	Gray	Switzerland
250V 	8120-0698	6	Straight **NEMA6-15P			United States, Canada
220V 	8120-2956	2	Straight **DHCK 107	79	Gray	Denmark
	8120-2957	3	90°	79	Gray	

*CD = Check Digit (refer to Section VI).

**Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.

E = Earth Ground L = Line N = Neutral

Figure 2-2. AC Power Cables Available

2-12. 5518A to 5508A Interconnecting Cable

2-13. The 5518A interconnects to the 5508A with an 18-conductor cable HP Part Number 10793A/B/C. This cable has identical end connectors and provides all of the required power and signal interconnections. The HP logo on the cable is aligned with the connector key so that when the logo is oriented upward, the cable connector key will align properly with the rear panel connector. Connect one end to the 5508A rear panel jack marked LASER SOURCE. Connect the other end to the 18-pin connector on the rear panel of the 5518A Laser Head.

2-14. 10751A/B Air Sensor Connection

2-15. The 10751 has an interconnecting cable as an integral part of its assembly. Orient the HP logo on the cable upward and connect the 10-pin connector of the 10751 cable to the 5508A rear panel connector marked AIR SENSOR.

2-16. 10757A/B/C Material Temperature Sensor Connection

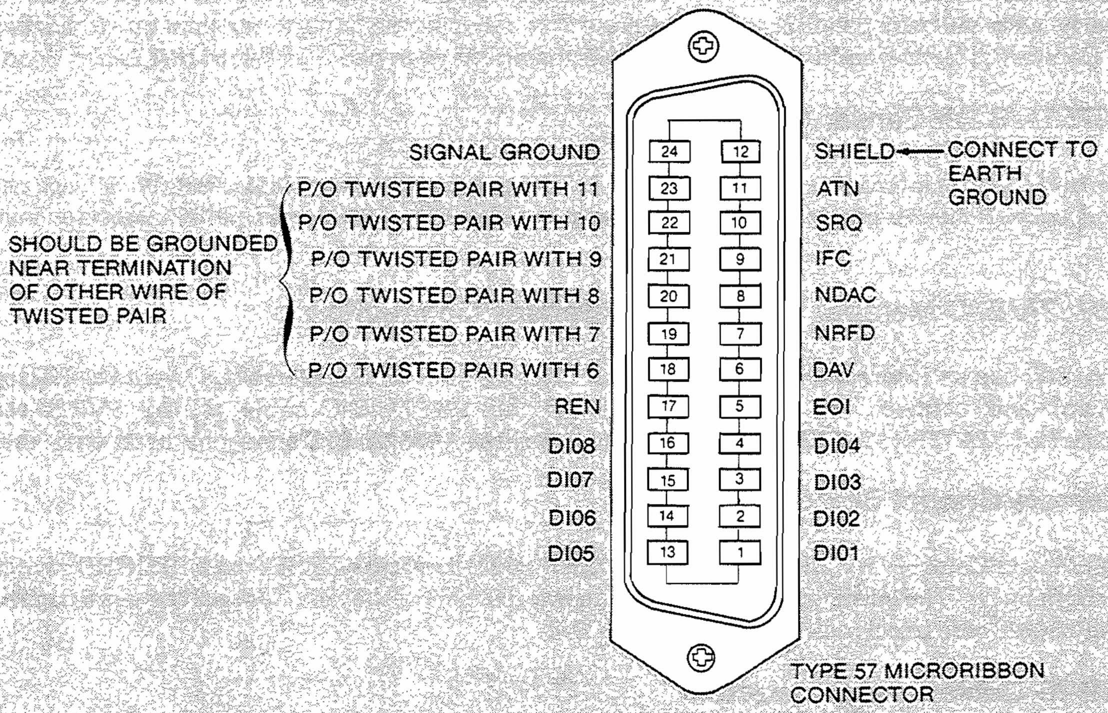
The 10757A/B/C has an interconnecting cable as an integral part of its assembly. Orient the HP logo on the cable upward and connect the 6-pin connector of the 10757A/B/C cable to the 5508A rear panel connectormarked MATERIAL TEMPERATURE. Up to three 10757A/B/C's may be used with the system.

2-18. Remote Control Box Connection

2-19. The Remote Control Box HP Part Number 05508-60021 contains RESET and RECORD switches and a BEAM strength meter. The interconnecting cable is an integral part of the box. Connect the 4-pin connector of the cable to the 5508A rear panel jack marked RMT CONT.

2-20. HP-IB Cables and Connectors

2-21. The HP-IB connector on the 5508A rear panel (marked IEEE STD 488 PORT) connects to external equipment such as a controller by means of controller cable accessories or HP-IB Interconnection cables HP 10631A/B/C/D or 10833A/B/C/D. Each end of the cable has a piggy-back connector which will accommodate both male and female mating connectors. This allows cables to be stacked to accommodate up to 15 instruments on the bus. The maximum length of cable that can be used to connect a group of instruments should not exceed 2 metres (6.5 feet) times the number of instruments to be interconnected or 20 metres (65.6 feet) whichever is less. Figure 2-3 shows the HP-IB connector, mating connector part numbers, available cables, logic levels, and signal name information.


SIGNAL GROUND
P/O TWISTED PAIR WITH 11
P/O TWISTED PAIR WITH 10
P/O TWISTED PAIR WITH 9
P/O TWISTED PAIR WITH 8
P/O TWISTED PAIR WITH 7
P/O TWISTED PAIR WITH 6
SHOULD BE GROUNDED NEAR TERMINATION OF OTHER WIRE OF TWISTED PAIR
REN
DI08
DI07
DI06
DI05
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
SHIELD
CONNECT TO EARTH GROUND
ATN
SRQ
IFC
NDAC
NRFD
DAV
EOI
DI04
DI03
DI02
DI01
TYPE 57 MICRORIBBON CONNECTOR

Logic Levels:

The Hewlett-Packard Interface Bus logic levels are TTL compatible, i.e., the true (1) state is 0.0 Vdc and the false (0) state is +2.5 Vdc to +5.0 Vdc.

Mating Connector:

HP 1251-0293; Amphenol 57-30240

Mating Cables Available:

HP 10631A or 10833A, 1.0 metre (3 feet)
HP 10631B or 10833B, 2.0 metres (6 feet)
HP 10631C or 10833C, 4.0 metres (12 feet)
HP 10631D or 10833D, 0.5 metre (1.5 feet)

Figure 2-3. Hewlett-Packard Interface Bus Connections

2-22. The information below the IEEE STD 488 PORT lettering describes the HP-IB capabilities for the 5528A system. See *Table 1-2* for details. HP-IB operation and programming are all covered in Section III.

2-23. OPERATIONAL VERIFICATION CHECK

2-24. Refer to Paragraph 3-23 for a step-by-step procedure to verify proper equipment operation.

2-25. OPERATING ENVIRONMENT

2-26. The system equipment can be operated in environments within the following limits:

Temperature: 0 to 40 °C (32 to 104°F)

Altitude: 3,048 meters (10,000 feet)

2-27. STORAGE AND SHIPMENT

2-28. Environment

2-29. The system can be stored or shipped in environments within the following limits:

Temperature: -40 to 75 °C (-40 to 167°F)

Altitude: 15,240 meters (50,000 feet)

2-30. The instrument should also be protected from temperature extremes which could cause condensation within the instrument.

3-21. Packaging

NOTE

The laser tube assembly MUST be shipped in an approved HP container.

2-32. The laser tube assembly (05518-60301) should only be shipped in an HP container designed for that purpose. In addition, the container must indicate that the laser tube contains magnetic material. To exchange the laser assembly, first order the replacement assembly and upon receipt return the old assembly in the same container. If it is necessary to ship a laser assembly, contact your nearest HP Sales office for an approved container.

2-33. Tagging for Service.

2-34. Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to HP for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also mark the container "FRAGILE" to ensure careful handling. The container for the 5518A should indicate the instrument contains magnetic material. in any correspondence, refer to the instrument by model number and full serial number.

2-35. Other Packaging. The following general instructions should be used for re-packing the system components with commercially available materials. These methods DO NOT apply to the laser tube assembly (05518-60301) which MUST be shipped in an HP approved container. If the laser assembly has not been removed from the 5518A, the 5518A may be packaged and shipped with the methods below.

a. Wrap instrument in heavy paper or plastic. (If shipping to Hewlett-Packard office or service center, attach a tag indicating the type of service required, return address, model number, and full serial number.)

b. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.

c. Use a layer of shock-absorbing material 70 to 100mm (3 to 4 inches) thick around all sides of the instrument to provide firm cushioning and prevent movement inside the container. Protect the front panel with cardboard.

d. Seal shipping container securely.

e. Mark shipping container FRAGILE to ensure careful handling. Indicate if magnetic material is enclosed.

f. In any correspondence, refer to instrument by model number and full serial number.

2-36. MOUNTING AND FIXTURING

2-37. Instructions for mounting the laser head, optics, and the display unit are contained in the User's Guide for the 5528A System.

SECTION III
OPERATION

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SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section provides operating information for personnel responsible for the installation and maintenance of the 5528A Laser Measurement System. A separate User's Guide is supplied that is written for those using the system to perform precision measurements. This section describes operation features of the instruments including front and rear panel controls and connectors, operator's checks, self-tests, and data transfer capabilities.

3-3. The 5528A User's Guide contains information required to apply and operate the 5528A system for various measurements. Included are measurement accuracy considerations, and setup and alignment instructions.

3-4. 5508A MEASUREMENT DISPLAY, FRONT PANEL CONTROLS AND KEYBOARD FEATURES

3-5. Following are descriptions of the 5508A front panel features shown in Figure 3-1.

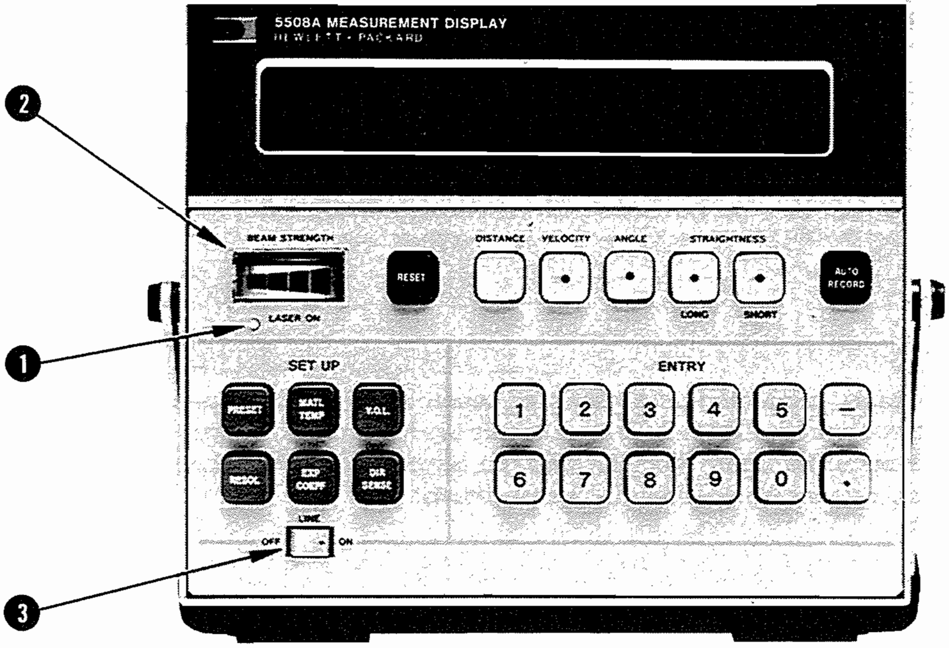

5508A MEASUREMENT DISPLAY
HEWLETT • PACKARD
2
BEAM STRENGTH
RESET
DISTANCE
VELOCITY
ANGLE
STRAIGHTNESS
AUTO RECORD
LONG
SHORT
LASER ON
1
SET UP
ENTRY
PRESET
MAT'L TEMP
V.O.L.
RESOL
EXP COEFF
DIR SENSE
1
2
3
4
5
—
6
7
8
9
0
.
LINE
OFF
ON
3

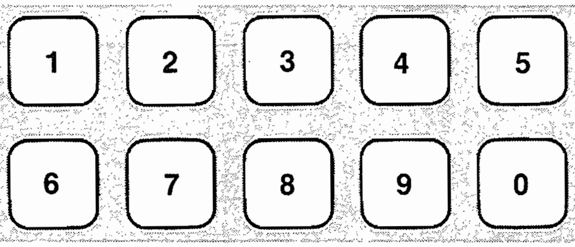
Figure 3-1. 5508A Measurement Display, Front Panel Controls and Indicators

①

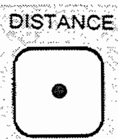
LASER ON Indicator. A yellow LED indicator installed to alert the operator that the 5518A Laser Head is activated and emitting a laser beam. Electrically, this indicator monitors the 5508A +5 Volt power supply line.

②

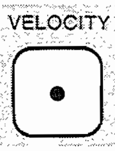
BEAM STRENGTH Meter. Indicates the relative strength of the laser beam measurement signal. The meter reading can be used to aid in optimizing the optical alignment of the laser and measurement optics. Beam strength indications within the green area of the meter are required for proper operation.



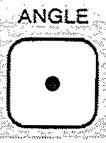
ENTRY Keys. The ENTRY keys allow the user to assign values to certain parameters. No measurement information is lost when entering numbers into the Measurement Display.



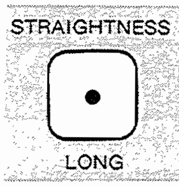
DISTANCE Key. The distance mode should be selected when linear measurements are performed. The 10766A Linear Interferometer and the 10767A Retroreflector are the optical instruments required for linear measurements. The positions of the interferometer and the retroflector at the time that the RESET key is pressed determine the zero reference point for the measurement.



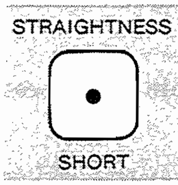
VELOCITY Key. The velocity mode is used for linear measurements only. Velocity can be monitored momentarily during linear measurements with no loss of data.



ANGLE Key. Selects the angular mode to measure, calculate, and display the relative angular displacement between the 10770A Angular Interferometer and the 10771A Angular Retroreflector.



LONG STRAIGHTNESS Key. Selects the long range straightness mode to measure and display the relative motion between the 10775A Optics. The 10775A consists of a long range straightness interferometer and a long range straightness reflector. The measurement is made in an axis parallel to the long side of the straightness reflector.



SHORT STRAIGHTNESS Key. Selects the short range straightness mode to measure and display the relative motion between the 10774A Optics. The measurement is made in an axis parallel to the long side of the straightness reflector. The 10774A consists of a short range straightness interferometer and a short range straightness reflector.

PRESET Key. Selects a function depending on the current measurement mode. Offset values can be preset in the distance and velocity modes. Multiplication factors can be preset in the angular and straightness modes. The default values are zero for distance and velocity, and 1 for angular and straightness. The PRESET key can be used any time without loss of measurement data. Changing a preset value in any one particular mode does not affect the preset values of the other modes.

TO ENTER A PRESET NUMBER, select the preset value with the ENTRY keys and press PRESET. The preset value is displayed as long as the PRESET key remains depressed. Upon release, the 5508A returns to its current measurement mode.

TO VIEW THE CURRENT PRESET NUMBER, press the PRESET key and the preset number will be displayed until either the PRESET key is pressed again, or another mode of operation is selected. The preset functions, default values, and ranges are given in Table 3-1.

INCORRECT PRESET VALUES will result in an error, see Table 3-1 for limits. If an attempt is made to enter a preset value outside of the ranges listed in Table 3-1, the display will indicate "Or Error" or "Ur Error". The Or Error message appears for out of range positive entries, the Ur Error message occurs for out of range negative entries. Another press of the PRESET key, results in the display indicating the maximum value (positve or negative) allowable in the current mode of operation, and still another press of the PRESET key results in a return to the current measurement mode with the maximum value entered as the preset value. If it is not desired to enter the maximum value, use the ENTRY keys to select the desired value and press PRESET. "Or Error" and "Ur Error" are cleared by the above sequence without loss of measurement data.

Table 3-1. Preset Key Functions, Default Values, and Ranges

	Distance	**Velocity**	**Angle**	**Straightness**
FUNCTION	Display = Measured Displacement + Preset	Display = Measured Velocity + Preset	Display = Measured Angle × Preset	Display = Measured Displacement × Preset
DEFAULT	0	0	1	1
RANGE	±50,000 mm	±20,000 mm/min	0* to 2	0* to 3

*The 5508A will accept zero for a multiplier in the angle and straightness modes without displaying an error message. However, measurements will not be displayed, i.e., measurement × zero = zero.

RESOL

RESOL Key. Selects or displays the number of significant decimal places displayed on the 5508A during measurements. This key also sets the smoothing function on or off. The RESOL key can be used any time without loss of measurement data.

TO SELECT RESOLUTION, the resolution number (number of digits following the decimal point) is entered using the ENTRY keys followed by pressing the RESOL key.

TO DISPLAY THE CURRENT RESOLUTION, press the RESOL key. Pressing the key again reverts back to the current measurement mode.

INCORRECT RESOLUTION VALUES. If an attempt is made to enter a resolution number beyond the capability of the 5508A, the display will indicate "Or Error" or "Ur Error". The Or Error message appears for incorrect positive entries, the Ur Error appears for incorrect negative entries. Another press of the RESOL key, results in the display indicating the maximum resolution value allowed in the current measurement mode, and still another press of the RESOL key results in a return to measurement mode with the maximum (positive or negative) value selected for the resolution number. If it is not desired to enter the maximum value, simply enter the desired number and press RESOL. "Or Error" and "Ur Error" are cleared by the above sequence without loss of measurement data.

RESOLUTION LIMITS are different for each measurement mode with english unit resolution one place greater than the metric equivalent. This may be observed by viewing the current resolution and toggling the ENGLISH-METRIC switch on the 5508A rear panel. Except as noted below, changing the unit switch setting does not alter the smoothing function.

SMOOTHING. Displacement data is averaged by the 5508A to reduce display jitter. The smoothing function can be defeated when selecting the display resolution. To defeat smoothing, enter the desired resolution number preceeded by a minus sign (- key in the ENTRY key group).

EXAMPLE (distance mode with english mode selected)

4 RESOL

sets the display to 4 places after the decimal point with smoothing on

EXAMPLE (distance mode with english mode selected)

– 5 RESOL

sets the display to 5 places after the decimal point with smoothing off

NOTE

Smoothing is disabled in the Linear measurement mode by measurement velocities in excess of 38.1 mm/minute. Smoothing is also disabled in the Velocity mode by measurement accelerations in excess of 13,750 mm/minute/minute.

MATL TEMP

MATL TEMP Key. The HP 10757A/B/C Material Temperature Sensors are used to compensate for thermal expansion or contraction of the material being measured by the HP 5528A System. The MATL TEMP key can be used any time without loss of measurement data. The MATL TEMP key can be used to:

a. display the average temperature of all sensors connected
b. display the temperature of each individual sensor connected
c. display the default average temperature value (20°C or 68°F) if all sensors are disconnected
d. enter an average workpiece temperature when all sensors are disconnected

THE RANGE of the HP 10757A/B/C Material Temperature Sensor is 0° to 40°C (32° to 104°F). When sensors reach temperatures outside of this range, appropriate error messages are displayed by the HP 5508A. See Paragraph 3-8 ERROR MESSAGES for explanation of these messages. The same error messages are used when temperature signal errors occur due to hardware failures.

TO DISPLAY THE AVERAGE TEMPERATURE, press the MATL TEMP key. An "A" (average) appears on the left-hand side of the display, and the temperature (fixed to two decimal places) is shown on the right followed by a "C" or an "F" (centigrade or fahrenheit) depending on the setting of the ENGLISH-METRIC switch.

Each successive press of the TEMP key will display the temperature of the sensors in the order; 1, 2, and 3. If the next sensor to be read is disconnected, the 5508A will skip that reading. Thus, if only sensors 1 and 3 are connected, successive presses will give the average temperature, the temperature at sensor 1, the temperature at sensor 3, and a return to the measurement mode. If all sensors are disconnected, successive presses will show the average temperature and then a return to mode.

While displaying the temperature of a particular sensor, if another function is selected, and then MATL TEMP is selected again, the display reverts back to the last displayed sensor. Successive presses will then go through the remaining sensors as described above.

For example, assume all three temperature sensors are connected and the temperature of sensor number 2 is displayed. If the VELOCITY key is pressed to determine how fast the optics are moving, and then the MATL TEMP key is pressed again, the temperature at sensor number 2 will be displayed again. Successive presses will then yield the temperature at sensor 3, and then a return to mode.

TO ENTER AN AVERAGE TEMPERATURE the temperature is entered (in F or C depending on the position of the ENGLISH-METRIC switch) followed by pressing the MATL TEMP key. Upon pressing the MATL TEMP key, the entered temperature will be displayed (fixed to two decimal places) and when released, the 5508A will return to its former mode of operation. The default value (no sensors connected) for the average temperature is 68°F or 20°C.

NOTE

The average temperature can be entered by the user only when the 10757A/B/C Material Temperature Sensors are NOT ATTACHED to the 5508A.

If an average temperature is entered when there are sensors connected, the 5508A will ignore the entered value and simply average the temperatures coming from the sensors. This process may take up to three seconds, however, and if the MATL TEMP key is pressed quickly after an average temperature is entered, the entered temperature may be observed on the display for a short time.

The only exception to the above is when a sensor error occurs. That is, when a temperature sensor either malfunctions or goes out of range while still connected. When this type of error occurs, a sensor error message is displayed and the next press of the MATL TEMP key will yield "A ERROR" indicating a problem with one of the sensors. Successive presses will scroll through the sensors which are in range and pass over the bad sensor(s) as if it were disconnected.

INCORRECT MATL TEMP VALUES will result in an error. If an attempt is made to enter a temperature outside the range of 0 to 50°C (32 to 122°F) the display will indicate "Or Error" or "Ur Error". The Or Error occurs for entries over 50°C, the Ur Error message occurs for entries below 0°C. Another press of the MATL TEMP key, results in the display indicating the maximum or minimum temperatures allowable, and still another press of the MATL TEMP key results in a return to mode with the maximum or minimum temperature selected as the average temperature. If it is not desired to enter the maximum value, use the ENTRY keys to select the desired value and press MATL TEMP. "Or Error" and "Ur Error" are cleared the above sequence without loss of measurement data.

NOTE

> If a sensor is connected or disconnected while the 5508A is in operation, a measurement error may result.

EXP
COEFF

EXP COEFF Key. Used to enter and display the expansion coefficient of the material being measured. The expansion coefficient is expressed in parts per million per degree of temperature, hereafter referred to as ppm. The expansion coefficient range is -720 to +720 ppm and the default for this key is 0.0. The EXP COEFF key can be used any time without loss of measurement data.

TO ENTER AN EXPANSION COEFFICIENT VALUE, enter the value with the ENTRY keys and press the EXP COEFF key. The value will be displayed until the key is released. Upon releasing the key, the 5508A display will return to the current measurement mode.

TO VIEW THE EXPANSION COEFFICIENT, press the EXP COEFF key and the value will be displayed until either the EXP COEFF key is pressed again, thus returning to the current mode, or another key is pressed.

INCORRECT EXP COEFF VALUES will result in an error. If an attempt is made to enter an expansion coefficient value in excess of ±720 ppm, the display will indicate "Or Error" or "Ur Error". The Or error occurs for incorrect positive entries, the Ur Error occurs for incorrect negative entries. Another press of the EXP COEFF key will display the maximum value allowed (±720 ppm). Another press of the EXP COEFF key will return the 5508A to the measurement mode with the maximum value entered. If it is not desired to enter the maximum value, use the ENTRY keys to select the desired value and press EXP COEFF. "Or Error" and "Ur Error" are cleared by the above sequence without loss of measurement data.

V.O.L. Key. The V.O.L. key can be used to display or select the Velocity of Light Compensation number. The V.O.L. number is used by the 5508A to correct for the dependence of laser wavelength on atmospheric conditions. The V.O.L. number used by the 5508A is 0.999abcd, however, only the abcd part of this number is displayed on the 5508A in the form abc.d. The 5508A multiplies measurement data by the V.O.L. Compensation numbers before the data is displayed. Velocity of Light Compensation is not necessary for angular or straightness measurements but can be used for all others.

The V.O.L. number is derived from measurements provided by the 10751A/B Air Sensor. If the 10751A/B is not used, the V.O.L. number defaults to 728.8. The DEFAULT VALUE (728.8) corresponds to 20°C air temperature, 760 mm Hg air pressure, and 50% relative humidity.

TO VIEW THE CURRENT COMPENSATION NUMBER, press the V.O.L. key. Successive presses will give the air temperature, the air pressure, and finally the air humidity. Since all three values are provided by the 10751A/B, unless a failure or sensor error occurs, they are either all present, or all absent. If the 10751A/B is used, the compensation number is updated approximately every three seconds by the 5508A.

While displaying the value of a particular air sensor measurement, if another function is selected, and then the V.O.L. key is pressed again, the display reverts back to the last displayed value. Successive presses will then go through the remaining sensors as described above.

For example, if the air pressure is being monitored, and it is desired to momentarily select another function, when the V.O.L. button is pressed again, the first data displayed will be the air pressure. Successive presses of the V.O.L. key will then give air humidity and then a return to the current measurement mode.

TO ENTER IN A NEW COMPENSATION NUMBER, enter the number with the ENTRY keys and press the V.O.L. key. The number, fixed to one decimal place will be displayed until the key is released. When the key is released, the 5508A returns to the current measurement mode.

NOTE

The Velocity of Light Compensation number can be selected by the user only when the 10751A/B Air Sensor is NOT ATTACHED to the 5508A.

INCORRECT COMPENSATION NUMBERS will result in an error. If an attempt is made to enter a displayed compensation number in excess of 999.9 or a negative value, the display will indicate "Or Error" or "Ur Error", respectively. Another press of the V.O.L. key, results in the display indicating the maximum (1000.0) or minimum (0.0) values allowable, and still another press of the V.O.L. key results in a return to measurement mode with the maximum value or minimum value entered as the compensation number. "Or Error" and "Ur Error" are cleared by the above sequence without loss of measurement data.

NOTE

The 5508A will allow 1000.0 to be entered as the displayed compensation number. This is a special case that sets the V.O.L. Compensation number to exactly 1.0000000.

WHEN AIR SENSOR ERRORS OCCUR, the appropriate message immediately appears on the display (unless there is a higher priority error) and the next press of the V.O.L. key will yield "C ERROR" indicating that an error condition exists with one of the air sensor measurements. Successive presses will display the valid air sensor data, and pass over the invalid sensor data.

NOTE

Connecting or disconnecting the 10751A/B Air Sensor during a measurement may result in a measurement error.

DIR SENSE

DIR SENSE Key. Reverses the sense of the measurement. For example, if the optics are moving apart and the display indicates an increasing positive displacement, pressing the DIR SENSE key will result in the same movement causing an increasing negative displacement or a decreasing positive displacement.

The DIR SENSE key may be pressed at any time without losing the current data. Also this key reflects the current position about the preset value. For example, if the preset value is 5.00000 and the display reads 7.00000, pressing the DIR SENSE key will result in a display of 3.00000.

RESET

RESET Key. When pressed, all measurment data taken up to that time is lost. While the key is being held in, the display fills with zeros and upon release, the 5508A returns to the measurement mode selected prior to RESET.

NOTE

The RESET key clears only the measurement data. If user selectable values have been entered via the 5508A ENTRY keys, these values will not be changed by RESET.

ERROR MESSAGES are displayed for certain operational errors, measurement errors and failures. These error messages are cleared by pressing RESET. After measurement errors or failures have been corrected, press RESET. However, error messages that occur due to improper use of a SET UP key can be cleared by the SET UP key without loss of measurement data. See the particular SET UP key description. Paragraph 3-8 contains a list of all 5508A ERROR MESSAGES.

If measurement errors or failures are not corrected when the RESET key is released, the 5508A will try to return to its former mode of operation and the same error message will again be displayed. This message will appear almost instantaneously with the exception of sensor errors which could take up to three seconds to reappear.

If the RESET key is pressed while viewing a temperature sensor value, resolution number, etc., the 5508A will return to the most recently selected measurement mode.

THE HP-IB LOCAL FUNCTION is performed by the RESET key. The HP-IB LOCAL function releases the instrument from HP-IB control.

AUTO RECORD

AUTO RECORD Key. This key provides a means to record data on external devices at user selectable rates. The 5508A is designed with HP-IB capability to allow this type of data transfer. HP-IB (Hewlett-Packard Interface Bus) is Hewlett-Packard Company's implementation of the IEEE Standard 488 Interface Bus.

To use the AUTO RECORD function, connect an HP-IB compatible device to the bus connector on the 5508A rear panel (IEEE STD 488 PORT). The recording device should be configured as an HP-IB listener according to its Operating Manual. Further information on HP-IB terminology and capabilities is provided in Paragraph 3-30, Data Transfer to External Devices, through Paragraph 3-64.

NOTE

> To transfer data to a device configured in its HP-IB "Listen Only" mode, the 5508A must be configured in its "Talk Only" mode. See Paragraph 3-62 for instructions on selecting the "Talk Only" mode.

SELECTING AUTO RECORD OUTPUT RATES. Time increments over the nominal range of 0.05 seconds to 12 seconds in steps of 0.05 second are allowed, however time increments should be selected which do not exceed the maximum input rate of the listening device.

To record timed samples, enter the time increment with the ENTRY keys, and press the AUTO RECORD key. The RCD annunciator will turn on and the current display will be transmitted over the HP-IB bus once per selected time increment. For example, 2 AUTO RECORD will cause output samples every 2 seconds. To turn off the auto record, press AUTO RECORD.

NOTE

> HP-IB ERRORS can occur when listener rates are not compatible. During auto record, the "Lr Error" (listener error) will be displayed when an attempt is made to output a data sample while the previous data sample has not yet been completely accepted by the HP-IB listener. This error will not occur if there is no listener connected and the 5508A is configured to Talk-Only on HP-IB.

MAXIMUM AUTO RECORD RATE. Pressing 0 AUTO RECORD transfers data to the listener at the rate of the slowest listening device. If a data sample has been completely transferred, then at the end of a 5508A update cycle, the updated display value will be held and made available for transfer.

❸

LINE Switch. When set to ON, power is applied to the HP 5508A Measurement Display, HP 5518A Laser Head, HP 10751A/B Air Sensor, and 10757A/B/C Material Temperature Sensors. The LASER ON indicators illuminate and the laser tube is powered. Also upon application of power, the system starts into a warm-up period during which a self-test diagnostic routine is executed.

3-6. 5508A MEASUREMENT DISPLAY, REAR PANEL CONNECTORS AND CONTROLS

3-7. Following are descriptions of the 5508A rear panel features shown in Figure 3-2.

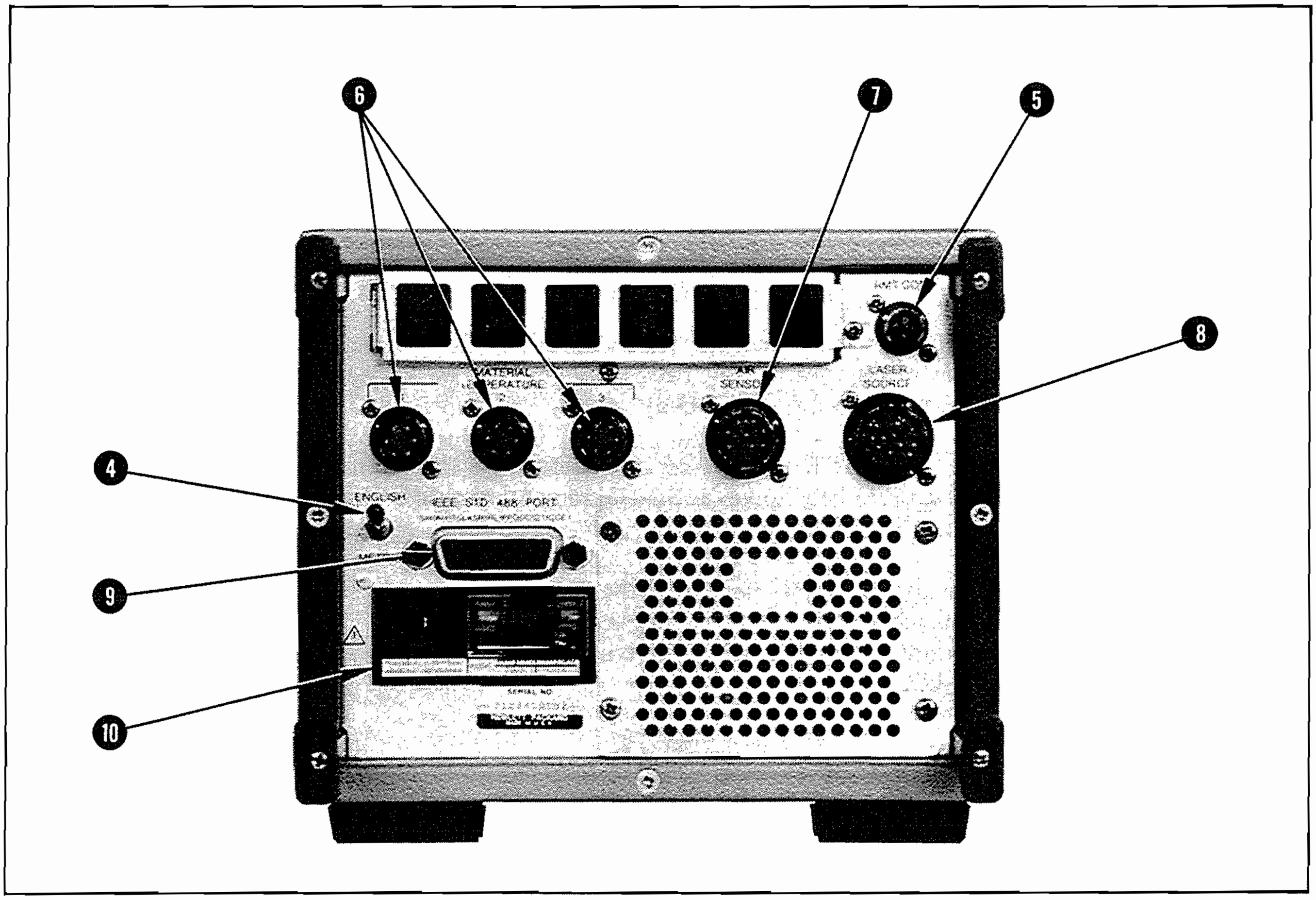

6
7
5
8
4
9
10
RMT CONT
MATERIAL TEMPERATURE
AIR SENSOR
LASER SOURCE
ENGLISH
IEEE STD 488 PORT
SERIAL NO

Figure 3-2. 5508A Measurement Display, Rear Panel Controls and Connectors

④

ENGLISH METRIC Switch. Determines the units of measurements, either English (inches, °F) or Metric (millimetres, °C).

The switch setting may be changed regardless of the 5508A function without loss of measurement data. It converts all temperatures, distances, and related constants while the 5508A remains in the current measurement mode. No RESET is required.

⑤

RMT CONT Connector. A 4-pin connector used to interconnect the 5508A with the remote control unit. The cable used to interconnect these two units is part of the remote control unit.

⑥

MATERIAL TEMPERATURE (1 through 3) Connectors. Three 6-pin connectors used to interconnect the 5508A with the 10757A/B/C Material Temperature Sensors. The cable used to interconnect these two units is part of the material temperature sensor.

⑦

AIR SENSOR Connector. A 10-pin connector used to interconnect the 5508A to the 10751A/B Air Sensor. The cable used to interconnect these two units is part of the air sensor.

⑧

LASER SOURCE Connector. An 18-pin connector used to interconnect the 5508A Measurement Display to the 5518A Laser Head. Use interconnecting cable HP Part Number 8120-3491. If this connector is left open when turning on the system, the 5508A display will read LASr FAIL after the unit goes through its full warm-up countdown.

⑨

IEEE STD 488 PORT (HP-IB) Connector. A 24-pin type 57 microribbon connector used to connect the 5508A to other equipment. The lettering just above the connector denotes the IEEE STD 488 (HP-IB) capabilities for the 5528A (see Table 3-5 for details). HP-IB is a Hewlett-Packard Company implementation of the IEEE 488 Standard Interface. See Section II for pinouts, signal names, and logic conventions. Information required to use the 5508A with HP-IB is covered in Paragraph 3-30, Data Transfer to External Devices through Paragraph 3-64.

⑩

POWER LINE Module. Contains a connector for the line cord, a fuse, and a line voltage selector. Details of line voltage selection, and power requirements, and line cords are contained in Section II.

3-8. ERROR MESSAGES

3-9. Table 3-2 lists error messages and their meaning. Note that the 5508A display is a 7-segment type and not alphanumeric thus messages appear in a mixture of upper and lower case. These error messages will appear on the 5508A display for the listed conditions.

Table 3-2. Error Messages

Error on Display	Condition
A Error	Material temperature average error
AE Error	Air Sensor temperature signal error
AH Error	Air Sensor humidity signal error
AP Error	Air Sensor pressure signal error
C Error	Compensation error (due to a sensor error)
FAIL 1	Failed part of [illegible] power-up self test
FAIL 2	Failed part [illegible]ower-up self test
FAIL 3	Failed part o[illegible]wer-up self test
FAIL 4	Failed part of 5[illegible]r-up self test
Hd Error	Laser Head error [illegible]
LASr FAIL	Flashes instead of L[illegible]hen 5518A is no[illegible]dy for operation at the end of the warm-up countdo[illegible]
Lr Error	Listener too slow (HP-I[illegible]
Or Error	Overrange error. Param[illegible]ange permits.
P1 Error	Material Temper[illegible]
P2 Error	Material [illegible]r
P3 Error	M[illegible]Sensor No[illegible]
PA Error	Be[illegible] – could indicate [illegible]rn beam in measurement path.
Pr Error	Pro[illegible]mming error (check user soft[illegible]P-IB controller).
SL Error	Signal loss error, could indicate exces[illegible]ty or problem in the measurement path.
Sr Error	Sample rate too high
SS Error	Processor failure or keyboard problem
Ur Error	Underrange error. Parameter value is smaller or more negative than range permits.

3-10. If these errors cannot be remedied by operator controls and appear to be hardware failures, refer to troubleshooting procedures in Section VIII.

3-11. 5518A LASER HEAD, FRONT PANEL CONTROLS AND INDICATORS

3-12. Followed are descriptions of the 5518A front panel features shown in Figure 3-3.

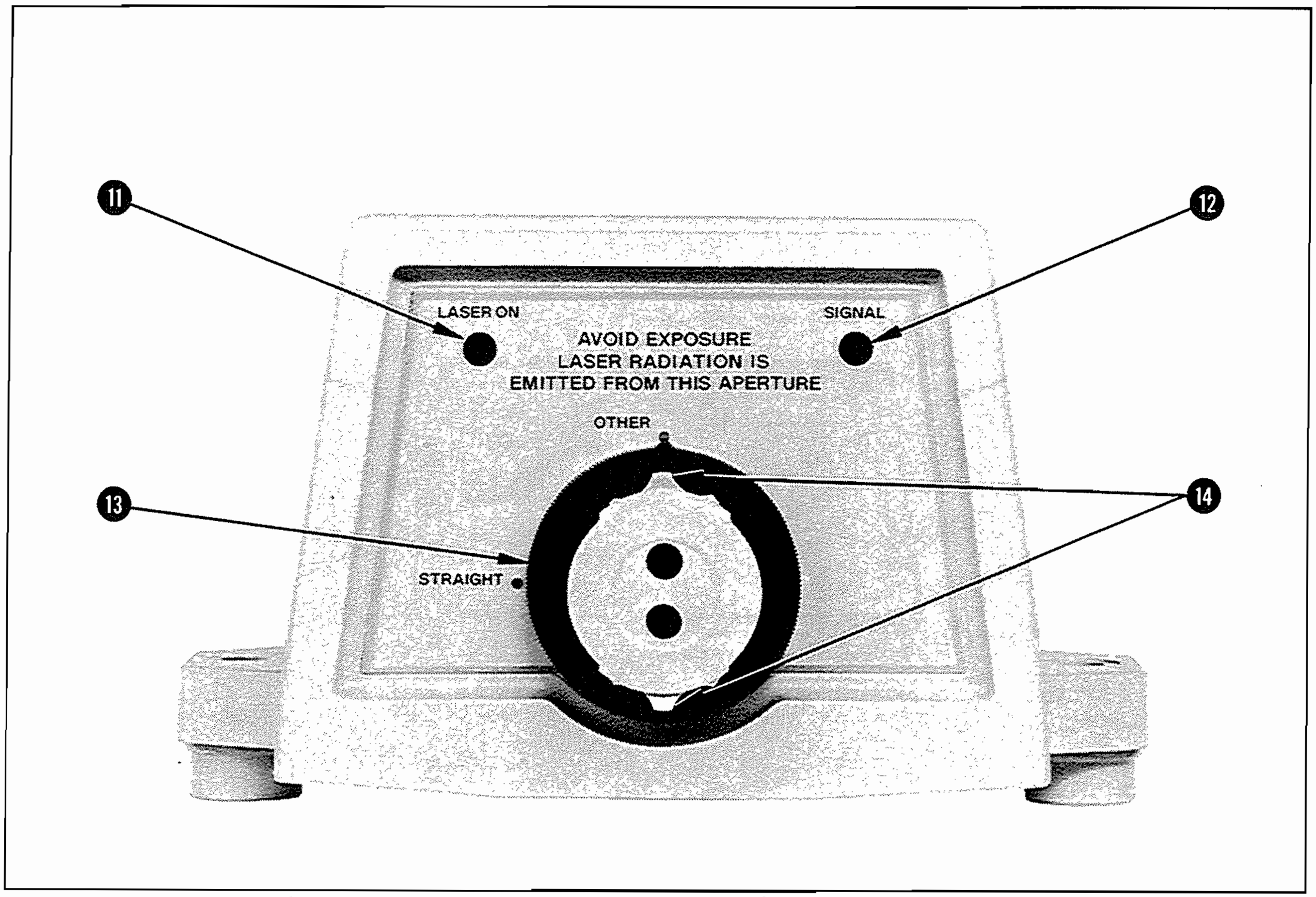

⑪
⑫
LASER ON
SIGNAL
AVOID EXPOSURE
LASER RADIATION IS
EMITTED FROM THIS APERTURE
OTHER
⑬
⑭
STRAIGHT

Figure 3-3. 5518A Laser Head, Front Panel Controls and Indicators

⑪

LASER ON INDICATOR. An amber indicator installed to alert the operator that the 5518A Laser Head is activated and emitting a laser beam. Electrically, this indicator monitors the +15 Volt line supplied by the 5508A which is used by the 5518A to generate its operating power.

⑫

SIGNAL Indicator. An amber indicator that indicates when a sufficient laser beam measurement signal is returned to the measurement receiver assembly within the 5518A.

⑬

TURRET Ring. A two-position measurement-type selector used to configure the 5518A for straightness measurements in the STRAIGHTNESS position or for all other types of measurements in the OTHER position.

⑭

TURRET Shutters. Shutters are located behind both apertures in the turret. For the exit shutter (top), three positions can be selected, open, reduced aperture, or closed. For the return shutter (bottom), two positions can be selected, open aperture or alignment target.

3-13. 5518A LASER HEAD, REAR PANEL INDICATORS AND CONNECTORS

3-14. Following are descriptions of the 5518A rear panel features shown in Figure 3-4.

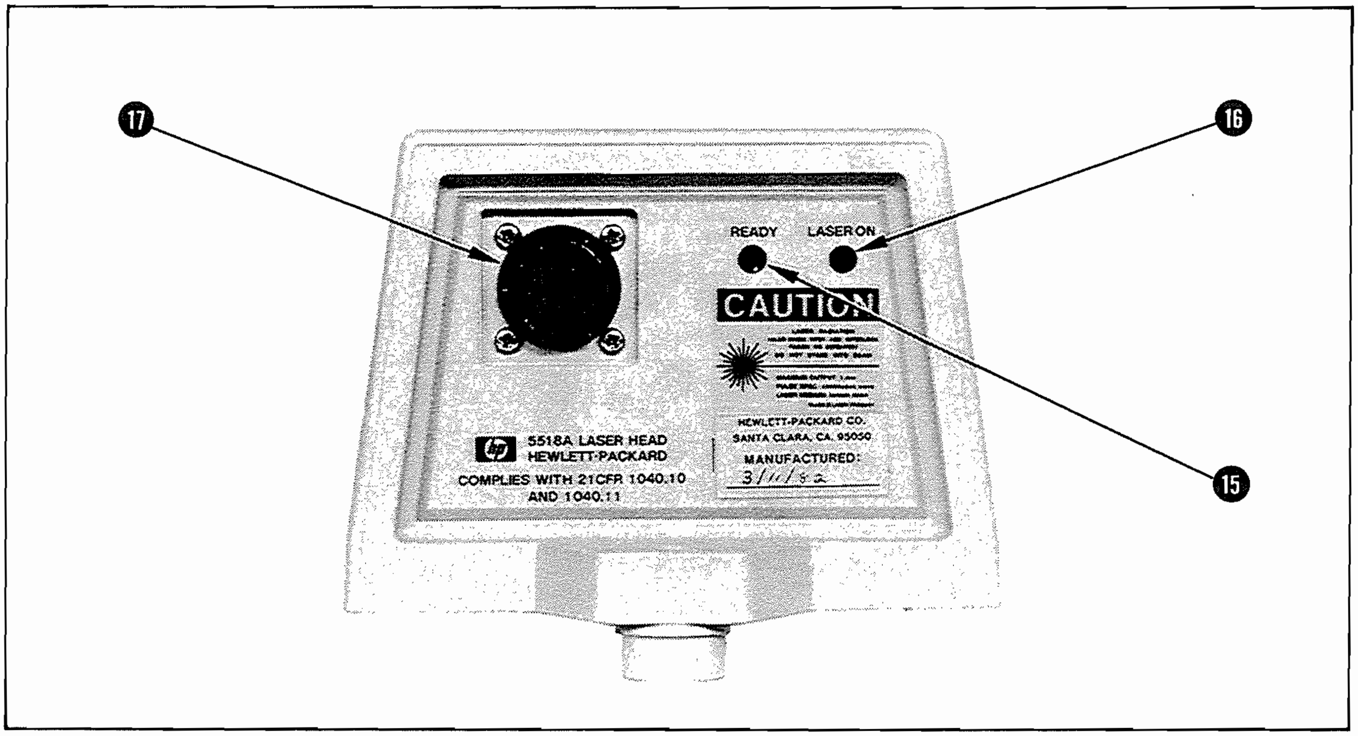

⑰
⑯
READY
LASER ON
CAUTION
HEWLETT-PACKARD CO.
SANTA CLARA, CA. 95050
MANUFACTURED:
3/11/82
5518A LASER HEAD
HEWLETT-PACKARD
COMPLIES WITH 21CFR 1040.10
AND 1040.11
⑮

Figure 3-4. 5518A Laser Head, Rear Panel Connectors and Indicators

⑮

READY Indicator. About half way through the laser warm-up period, this indicator will blink on and off to indicate that the laser is in the process of warming up. When the 5518A is ready for use, the LED assumes a steady on condition.

⑯

LASER ON Indicator. An amber indicator installed to alert the operator that the 5518A Laser Head is activated and emitting a laser beam. Electrically, this indicator monitors the +15 Volt line supplied by the 5508A which is used by the 5518A to generate the operating power.

⑰

5508A Connector. An 18-pin connector used to connect the 5518A Laser Head to the 5508A Measurement Display. Use interconnecting cable HP Part Number 8120-3491. If this connector is left open when turning on the system, the 5508A display will read LASr FAIL after the unit goes through its self-test and warm-up count down (approximately 10 minutes).

3-15. 10751A/B Air Sensor Controls

3-16. The Air Sensor (Figure 3-5) measures the atmospheric conditions and supplies the 5508A with data to derive the Velocity-of-Light Compensation number. The compensation number is used to correct for the dependence of laser wavelength on atmospheric conditions. The 10751A/B contains sensors for air temperature and air pressure. The relative humidity is set with the HUMIDITY switch. Three positions are available, 25, 50, and 75%. See V.O.L. key description on Page 3-7 for further information. Also see AIR SENSOR connector on Page 3-11.

3-17. The following guidelines should be used to minimize V.O.L. Compensation errors when setting the Humidity switch. See 5528A system specifications in Section I.

Switch Setting	Humidity Range
25%	0 to 37.5%
50%	37.5% to 62.5%
75%	62.5% to 95%

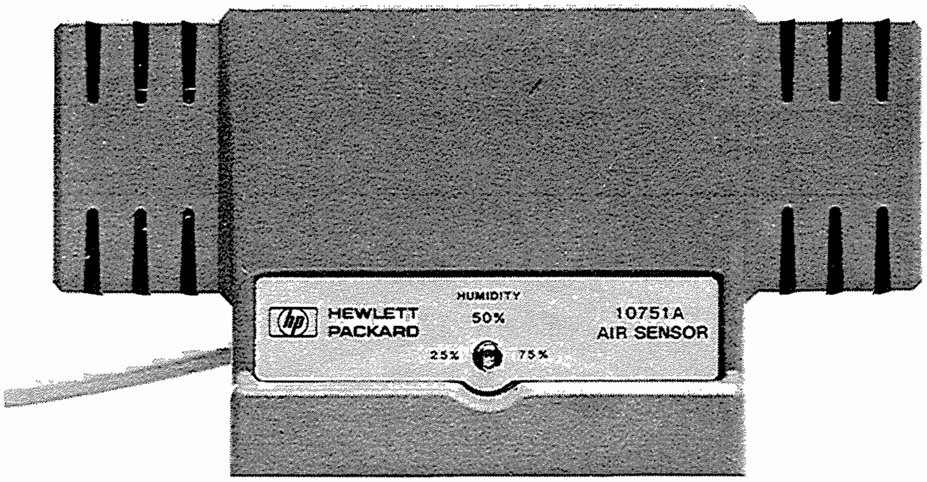


Figure 3-5. 10751A/B Air Sensor, Controls

3-18. 10757A/B/C MATERIAL TEMPERATURE SENSORS

3-19. The Material Temperature Sensors (Figure 3-6) are used to compensate for thermal expansion or contraction of the material being measured by the 5508A System. There are no controls or indicators. See MATL TEMP key description on Page 3-5 for further information. Also see MATERIAL TEMPERATURE connectors on Page 3-11.

3-20. THE RANGE of the 10757A/B/C Material Temperature Sensor is 0°C to 40°C (32°F to 104°F). When sensors reach temperatures outside of this range, appropriate error messages are displayed by the 5508A. See Paragraph 3-8 ERROR MESSAGES for explanation of these messages. The same error messages are used when temperature signal errors occur due to hardware failures.

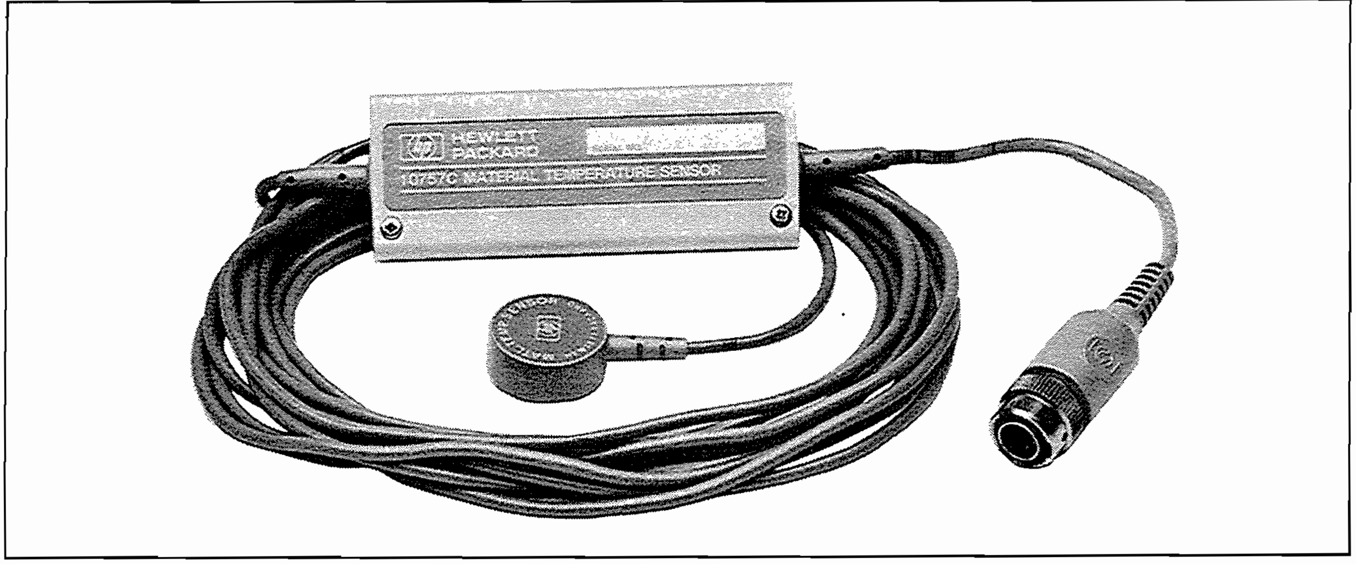

HEWLETT PACKARD
10757C MATERIAL TEMPERATURE SENSOR

Figure 3-6. 10757A/B/C Material Temperature Sensors

3-21. REMOTE CONTROL UNIT 05508-60021 CONTROLS AND INDICATORS

3-22. The Remote Control Unit (Figure 3-7) provides three remote functions. The beam strength meter duplicates the function of the 5508A BEAM STRENGTH meter, see Page 3-2. The RESET switch duplicates the 5508A RESET function, see Page 3-8. The RECORD switch is used to trigger the 5508A in order to transmit selected data to external devices. This function is similar to the AUTO RECORD function, see description of the 5508A AUTO RECORD key on Page 3-9 for information required to output data to an HP-IB listener. Also see RMT CONT connector on Page 3-10.

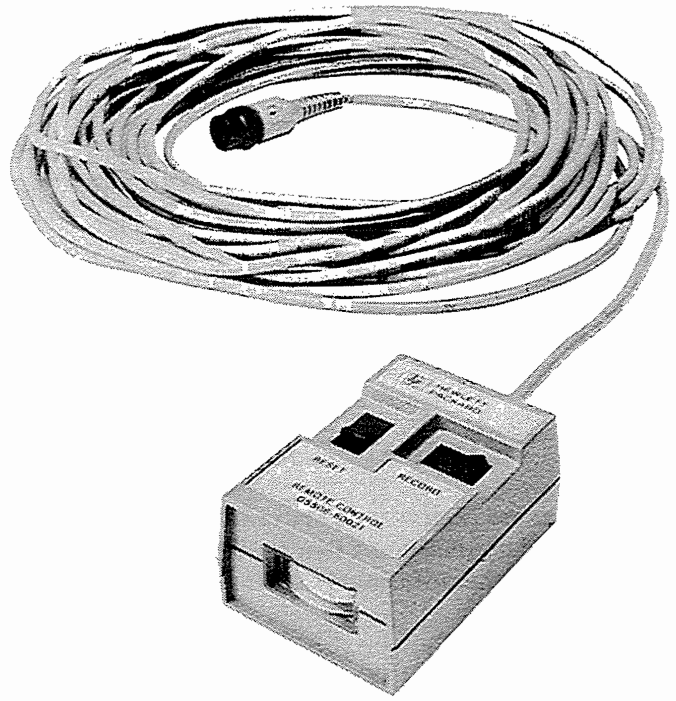

HEWLETT PACKARD
RESET
RECORD
REMOTE CONTROL
05508-60021

Figure 3-7. Remote Control Unit 05508-60021, Controls and Indicators

3-23. OPERATOR'S CHECK

WARNING

BEFORE THE 5508A IS SWITCHED ON, ALL PROTECTIVE EARTH TERMINALS, EXTENSION CORDS, AUTO-TRANSFORMERS AND DEVICES CONNECTED TO IT SHOULD BE CONNECTED TO A PROTECTIVE EARTH GROUNDED SOCKET. ANY INTERRUPTION OF THE PROTECTIVE EARTH GROUNDING WILL CAUSE A POTENTIAL SHOCK HAZARD THAT COULD RESULT IN PERSONAL INJURY.

FOR CONTINUED PROTECTION AGAINST FIRE, ONLY FUSES WITH THE REQUIRED RATING AND SPECIFIED TYPE SHOULD BE USED. DO NOT USE REPAIRED FUSES OR SHORT CIRCUITED FUSEHOLDERS.

LASER RADIATION IS EMITTED FROM THE APERTURE ON THE 5518A LASER HEAD.

CAUTION

Before switching on the AC power, the 5508A must be set to the voltage on the power source, or damage to the instrument may result. See Section II.

3-24. The following operating procedure describes a simple setup to allow a quick familiarization of the system operating controls and indicators. The optical alignment described here is adequate to perform the check but is not sufficent to make precision measurements. See the separate 5528A User's Guide for detailed optical alignment information.

3-25. Equipment Required

3-26. The following equipment is needed to perform the check:

1	5508A Measurement Display
1	5518A Laser Head
1	10751A/B Air Sensor (optional)
3	10757A/B/C Material Temperature Sensors (optional)
2	10784A Base
2	10785A Height Adjuster and Post
2	10767A Retroreflector
1	10766A Linear Interferometer
1	Bar or Straight Edge

3-27. Procedure

1. Refer to Section II, Paragraph 2-8, to determine if the 5508A is set up for the available line voltage.
2. Connect the 5518A as described in Paragraphs 2-10 through 2-17 in Section II, Installation. Do not connect the 10751A/B or 10757A/B/C.
3. Assemble the retroreflector assembly (see Figure 3-8) using a 10767A Retroreflector, a 10785A Height Adjuster and Post, and a 10784A Base. Throughout the remainder of this check this assembly will be referred to as the retroreflector assembly.

4. Assemble the interferometer assembly (see Figure 3-8) using a 10766A Interferometer, a 10767A Retroreflector, a 10785A Height Adjuster and Post, and a 10784A Base. Throughout the remainder of this check this assembly will be referred to as the interferometer assembly.

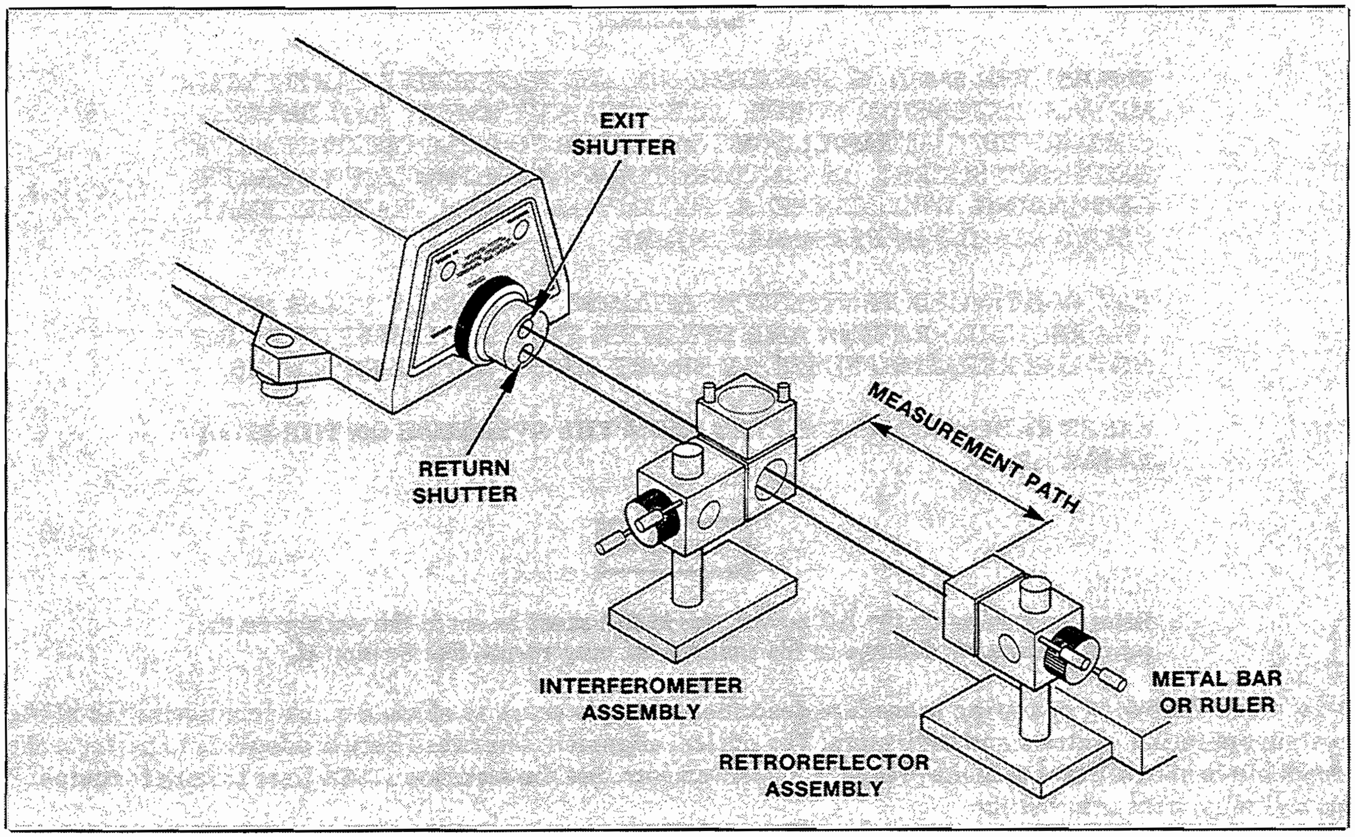


Figure 3-8. Linear Interferometer Equipment Setup

5. On 5508A rear panel, set units switch to the ENGLISH position.

WARNING

DO NOT STARE INTO THE LASER BEAM.

6. On the 5508A, set the LINE switch to ON and check that the 5518A Laser Head emits a red laser beam. If the beam is not obvious, a piece of white card stock may be used to view the beam. The diameter of the laser beam is controlled by the exit shutter (see Figure 3-3). Set the exit shutter to its full aperture position.

   The system will go through a self-test and warm-up period which requires approximately 3 to 10 minutes to complete. The 5508A self-test sequence is described in Paragraph 3-28. The 5518A READY indicator will begin to blink during the warm-up period. When READY assumes a constant lighted condition, the 5518A is ready for use. The warm-up period should end with "PA Error" (path error) on the display. If the 5508A fails its' self test or the warm-up countdown does not end with PA Error, see 5528A Block Diagram and System Troubleshooting in Section VIII.

7. Align the optics as follows:

   a. A bar or straight edge can be used as a straight reference line for the optics. Lay a bar or tape a straight edge on a bench along the line of the intended laser beam path.

b. Position the 5518A Laser Head so that the laser beam is in line with and parallel to the long dimension of the straight edge.

c. Place the retroreflector assembly (see Figure 3-8) about 2 feet from the laser head using the straight edge as a guide.

d. On the laser head, dial in the alignment target on the return shutter. Dial in the small diameter aperture on the exit shutter.

e. Adjust the retroreflector assembly and laser head so that the laser beam returns to the center of the crosshairs on the return shutter.

f. Place the interferometer assembly (see Figure 3-8) in between the laser head and the retoreflector assembly such that the laser beam passes through the interferometer according to the diagram on the 10766A Interferometer label.

g. Now that the interferometer assembly is in the path, there will be two beams returned to the 5518A instead of a single beam. One beam is returned from a reference optical path within the interferometer assembly and the other beam is returned from the measurement path between the interferometer assembly and the retroreflector assembly. Adjust the position of the interferometer assembly and/or retroreflector assembly as described below. Maximize the overlap of the two returned beams.

h. Between the interferometer assembly and retroreflector assembly, block the beam with a piece of card stock and observe if the remaining beam is incident on the center of the crosshairs. If so, the interferometer assembly is properly aligned. If not, reposition the interferometer assembly.

i. Unblock the beam and observe that the two returned beams are overlapped. If not, adjust the retroreflector assembly or 5518A for both beams overlapping at the center of the crosshairs.

j. When overlap is maximized, place the return shutter to the open position and the exit shutter to the large diameter position. The SIGNAL light on the 5508A should be ON and the BEAM STRENGTH meter should be steady and indicating in the green area.

8. Press RESET, the display should read "0.00000 IN". Note that the - (minus sign may be on or flashing and the low order digits may dither.

9. Move the retroreflector assembly away from the linear interferometer assembly approximately 1 inch. The display should indicate the displacement.

10. Press minus 55, then press MATL TEMP key. The display should read "Ur Error". Press MATL TEMP again, the display should read "A 32.00 F". Press MATL TEMP again, the display should return to the distance mode and read approximately 1 inch. Press MATL TEMP again, the display should read "A 32.00 F".

11. Press 150, then press MATL TEMP key. The display should read "Or Error". Press MATL TEMP again, the display should read "A 122.00 F". Press MATL TEMP again, the display should return to the distance mode and read approximately 1 inch. Press MATL TEMP again, the display should read "A 122.00 F".

12. Press EXP COEFF, the display should read the expansion coefficient default value of 0.0. Press EXP COEFF again to return to the measurement mode. Write down the exact value of the displacement. Press 720 EXP COEFF, note the new value of the displacement. The new value should be less than the old value by 38,880 parts per million [(122 -68) × 720 ppm = 38,880 ppm]. Press 0.0 EXP COEFF to disable material temperature compensation.

13. Press V.O.L., the display should read the V.O.L. compensation number default value of 728.8 ppm. Press V.O.L. again to return to the measurement mode. Write down the exact value of the displacement. Press 1000.0 V.O.L. Note the new value of the displacement. The new value should be greater than the old value by 271.2 parts per million (1000.0 ppm - 728.8 ppm = 271.2 ppm).

14. Press the following ENTRY keys 12 DECIMAL POINT. Then press PRESET. The display should read 12. plus the value of the distance measurement (approximately 13. inches).

15. Press 3000, then press PRESET. The display should read "Or Error". Press PRESET again, the display should read "2000.00000". Press PRESET again, the display should read approximately 2001 inches.

16. Press MINUS 3000, then press PRESET. The display should read "Ur Error". Press PRESET again, the display should read "-2000.00000". Press PRESET again, the display should read approximately -1999 inches.

17. Press 12. PRESET. The display should read approximately 13 inches.

18. Press DIR SENSE, the display should read 12 minus the last distance measurement made (approximately 11 inches). Press DIR SENSE again, display should read approximately 13 inches.

19. Press MINUS 6 RESOL, this disables the smoothing function and extends the resolution to 1 microinch causing the last digit to jitter considerably. The display should read approximately 13 inches to six decimal places.

20. Press 9, then press RESOL key. The display should read "Or Error". Press RESOL again, the display should read "6.". Press RESOL again, the display should return to the distance mode and read approximately 13 inches to 6 decimal places, with the smoothing function on.

21. Press minus 9, then press RESOL key. The display should read "Ur Error". Press RESOL again, the display should read "-6.". Press RESOL again, the display should return to the distance mode and read approximately 13 inches to 6 decimal places with the smoothing function off.

22. On the 5508A, set the LINE switch to off. Connect the 10751A/B to the 5508A rear panel jack marked AIR SENSOR. Connect the 10757A/B/C to the 5508A rear panel jacks marked MATERIAL TEMPERATURE 1, 2, 3. Set the 5508A LINE switch to ON. Wait for the 5508A to display LASEr UP.

23. Press MATL TEMP. If one or more sensors are connected, the display should read "A xx.xxF" where xx.xx is the average temperature of the sensors connected.

24. Press MATL TEMP again. The display should read "1 xx.xxF", the temperature of material sensor no. 1. If no sensor is connected to no. 1 jack, the display should read the number and temperature of the next sensor that is connected.

25. If more than one material sensor is connected, repeated pressing of the MATL TEMP key should display the next sensor number and its temperature reading. After the last sensor temperature has been displayed, the display should return to the distance mode.

26. Press V.O.L. The display should read "C xxx.xx" where xxx.xx is the compensation number (approximately 730 at sea level and at normal room temperature).

27. Press V.O.L. again, the display should read "A xx.xxF", the air temperature.

28. Press V.O.L. again, the display should read "P xx.xx IN", the air pressure.

29. Press V.O.L. again, the display should read "H xx." the selected humidity value. The value displayed is selected with the humidity switch on the 10751A/B. Set this switch to all three positions and check that the display reads "H 75.", "H 50.", "H 25.".

3-28. SELF-TEST AND WARM-UP COUNTDOWN

3-29. When power is first applied to the 5508A, the instrument goes through a self-test diagnostic routine. Successful completion of this self-test gives a high degree of confidence that the 5508A is functioning properly. At the end of the self-test, the 5508A begins a warm-up countdown sequence. The front panel display and annunciators should indicate in the following sequence:

Sequence	MSD									LSD
1	-1									
2		8.								
3			8.							
4				8.						
5					8.					
6						8.				
7							8.			
8								8.		
9									8.	
10										8.
11	0								Scrolling	0
12	1									1
13	2									2
14	3									3
15	4									4
16	5									5
17	6									6
18	7									7
19	8									8
20	9									9
21	ARC-SEC annunciator on with same display as 20									
22	mm annunciator on with same display as 20									
23	IN annunciator on with same display as 20									
24	/MIN annunciator on with same display as 20									
25	RCD annunciator on with same display as 20									
26	SHORT STRAIGHTNESS annunciator on with same display as 20									
27	LONG STRAIGHTNESS annunciator on with same display as 20									
28	ANGLE annunciator on with same display as 20									
29	VELOCITY annunciator on with same display as 20									
30	DISTANCE annunciator on with same display as 20									
31	PASS 1 on display (FAIL 1 if a circuitry problem is found)									
32	PASS 2 on display (FAIL 2 if a circuitry problem is found)									
33	PASS 3 on display (FAIL 3 if a circuitry problem is found)									
34	PASS 4 on display (FAIL 4 if a circuitry problem is found)									
35	CAL A xxx. on display (where xxx = internal calibration switch setting)									
36	CAL b xx. on display (where xx = internal calibration switch setting)									
37	Addr xx. or Addr OFF on display (where xx is the HP-IB address setting, factory setting = 3) (OFF = talk only mode)									
38	600 on display (first step of warm-up countdown)									
39	599 on display									
40	598 on display									
41	597 on display									
42	596 on display									
43	LASr COLD on display									
44	Cycle repeats with condition of the head (LASr COLd) displayed at multiples of 5. This continues until the 5518A Laser Head is ready for use (5508A will display flashing LASr UP) or 0 count is reached (flashing LASr FAIL). If a LASr FAIL display occurs, refer to Section VIII, Trouble Isolation.									

3-30. DATA TRANSFER TO EXTERNAL DEVICES (HP-IB)

3-31. Introduction

3-32. The 5508A Measurement Display is compatible with the Hewlett-Packard Interface Bus (HP-IB). HP-IB is Hewlett-Packard Company's implementation of the IEEE* Standard 488-1978. "Standard Digital Interface for Programmable Instrumentation". The HP-IB capability of the 5508A provides the user with a straightforward means of outputting measurement data to recording devices or, for more automated applications, the 5508A functions can be completely controlled via the interface.

3-33. HP-IB compatible devices are used in HP-IB systems in one or more of the following ways. As a LISTENER, a device must be capable of accepting data from the interface. Examples of Listeners are printers and plotters. As a TALKER, a device must be capable of outputting data to the interface. Examples of Talkers are voltmeters and tape readers. As a CONTROLLER, a device must be capable of specifying the Talker and Listener(s) of a data transfer (including itself).

3-34. The 5508A has full Talker capability, limited Listener capability, and no Controller capability. A listing of the 5508A HP-IB capabilities, called out in terms of the IEEE 488 Interface Function Codes, appears in Table 3-5, 5508A HP-IB Capabilities.

3-35. 5528A Data Transfer without an HP-IB Controller

3-36. The minimum HP-IB system configuration consists of a Talker and Listener(s) without a Controller. In this configuration, data transfer is limited to direct transfer from the Talker to the Listener(s). The 5508A uses the special HP-IB Talk-Only mode for this type of system. To set the 5508A to Talk-Only, the Talk/Only Addressable switch should be set accordingly. See Paragraph 3-62, HP-IB switches.

3-37. To configure the 5508A with a Listener, HP-IB Interconnecting Cable (HP 10833A/B/C/D) will generally be required. For example, if the 5528A is used with an HP-IB compatible printer, the intended printer may not be supplied with a cable. The Hewlett-Packard Catalog contains a special section on HP-IB compatible devices and accessories that are currently available.

NOTE

> HP-IB cable connectors have anchor screws used to secure them to HP-IB jacks. The 5508A requires the metric version of these screws. Metric threaded HP-IB screws have a black finish, english thread HP-IB screws have a metallic finish. All HP-IB cables are currently shipped with metric screws.

3-38. Information required to operate a particular device as an HP-IB Listener is contained in its Operating Manual. For example, to use a printer with the 5508A it will generally be required that the operator manually set the printer to the Listen-Only mode. This mode is typically selectable using a switch located on the printers' rear panel. IEEE Interface Function Codes L1 or L3 indicates listen only capability.

3-39. When the 5508A is configured with an HP-IB listener, the AUTO RECORD key on the front panel, or the RECORD key on the Remote Control Unit are used to control data transfer. See the AUTO RECORD key description, Page 3-9 and the RECORD switch description, Paragraph 3-22.

3-40. 5508A Operation with an HP-IB Controller

3-41. The HP-IB capability of the 5508A Measurement Display allows all of its measurement functions to be controlled via the interface. An HP-IB Controller can control the 5508A using BUS COMMANDS and the 5508A INSTRUMENT FUNCTION CODES. When the 5508A is used with a Controller its Talk-Only/Addressable Switch must be set to Addressable. See paragraph 3-62, HP-IB Switches.

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*IEEE = *Institute of Electrical and Electronic Engineers.*

3-42. 5508A Instrument Function Codes

3-43. The 5508A recognizes a set of Instrument Function Codes that allows its' measurement functions to be controlled via HP-IB. All measurement modes can be selected by an HP-IB Controller and parameter values, such as Average Material Temperature, can be accessed or entered depending on user requirements.

3-44. Using Instrument Function Codes

3-45. Controlling the 5508A using Instrument Function Codes is accomplished by outputting the Instrument Function Codes to the interface and addressing the 5508A to listen. The programming statements required to use a Controller to send Instrument Function Codes and address the intended bus device to listen will depend on the particular Controller.

EXAMPLES

A fixed point number preceding an Instrument Function Code is used to enter a value into the 5508A or to select an operating mode.

78TA	Set average material temperature to 78°.
2RC	Output data samples to HP-IB every 2 seconds.
1TP	Material Temperature Sensor #2 and #3 disabled.

3-46. Not all Instrument Function Codes can have preceding numbers. Those that can are indicated in Table 3-3. Numbers preceding other Instrument Function Codes are ignored.

MORE EXAMPLES (Note that Function Codes can be programmed as strings)

M1	Go into distance measurement mode.
72TA, M1	Set averaged material temperature to 72° and go into distance mode.
TA, RC	Load HP-IB output buffer with Average Material Temperature, output to HP-IB.
VL, RC	Load HP-IB output buffer with Velocity of Light Compensation Number and output to HP-IB.

NOTE

The front panel of the 5508A will indicate modes controlled by the HP-IB in the same way that it indicates the modes when selected using the front panel keys. For example when the value of TA is requested via HP-IB, the value of TA will also be displayed on the front panel display.

Table 3-3. 5508A Instrument Function Codes

<table>
<tr><th>Instrument Function Code</th><th>5508A Function</th></tr>
<tr><td>M1</td><td>Distance Mode</td></tr>
<tr><td>M2</td><td>Velocity Mode</td></tr>
<tr><td>M3</td><td>Angular Mode</td></tr>
<tr><td>M4</td><td>Long Straightness Mode</td></tr>
<tr><td>M5</td><td>Short Straightness Mode</td></tr>
<tr><td>P1*</td><td>Distance Preset</td></tr>
<tr><td>P2*</td><td>Velocity Preset</td></tr>
<tr><td>P3*</td><td>Angular Preset</td></tr>
<tr><td>P4*</td><td>Long Straightness Preset</td></tr>
<tr><td>P5*</td><td>Short Straightness Preset</td></tr>
<tr><td>R1*</td><td>Distance Display Resolution</td></tr>
<tr><td>R2*</td><td>Velocity Display Resolution</td></tr>
<tr><td>R3*</td><td>Angular Display Resolution</td></tr>
<tr><td>R4*</td><td>Long Straightness Display Resolution</td></tr>
<tr><td>R5*</td><td>Short Straightness Display Resolution</td></tr>
<tr><td>T1</td><td>Material Temperature Sensor No. 1</td></tr>
<tr><td>T2</td><td>Material Temperature Sensor No. 2</td></tr>
<tr><td>T3</td><td>Material Temperature Sensor No. 3</td></tr>
<tr><td>TA*</td><td>Average Material Temperature</td></tr>
<tr><td>AP</td><td>Air Pressure</td></tr>
<tr><td>AH</td><td>Air Humidity</td></tr>
<tr><td>AT</td><td>Air Temperature</td></tr>
<tr><td>VL*</td><td>V.O.L. Compensation Number</td></tr>
<tr><td>EC*</td><td>Expansion Coefficient</td></tr>
<tr><td>RC*</td><td>Record (Output to HP-IB)</td></tr>
<tr><td>RS</td><td>Reset</td></tr>
<tr><td>D1</td><td>Direction Sense at Power On</td></tr>
<tr><td>D2</td><td>Direction Sense Opposite to Power On</td></tr>
<tr><td>UE</td><td>English Units</td></tr>
<tr><td>UM</td><td>Metric Units</td></tr>
<tr><td>C0</td><td>Disables Compensation Number (Air and Material Temperature) Updating</td></tr>
<tr><td>C1</td><td>Enables Compensation Number (Air and Material Temperature) Updating</td></tr>
<tr><td>TP*</td><td>Selected Material Temp Sensor Enable</td></tr>
<tr><td>A0</td><td>Disables Velocity of Light Compensation Number Updating</td></tr>
<tr><td>A1</td><td>Enables Velocity of Light Compensation Number Updating</td></tr>
<tr><td></td><td>Additional Comments:</td></tr>
<tr><td>P1 through P5</td><td>Also Changes 5508A to Associated Measurement Mode</td></tr>
<tr><td>R1 through R5</td><td>Also Changes 5508A to Associated Measurement Mode</td></tr>
<tr><td>RC</td><td>If Auto Record is On, RC turns it Off</td></tr>
<tr><td>TP</td><td>TP is used with a preceding numeric value to selectively enable the 10757A/B/C Material TemperatureSensor readings. Disabled sensors still update temperature but the data is not used for compensation.</td></tr>
<tr><td></td><td>
<table>
<tr><th>Numeric Value Preceding TP</th><th colspan="3">Active Sensors</th></tr>
<tr><th></th><th>T3</th><th>T2</th><th>T1</th></tr>
<tr><td>1</td><td>No</td><td>No</td><td>Yes</td></tr>
<tr><td>2</td><td>No</td><td>Yes</td><td>No</td></tr>
<tr><td>3</td><td>No</td><td>Yes</td><td>Yes</td></tr>
<tr><td>4</td><td>Yes</td><td>No</td><td>No</td></tr>
<tr><td>5</td><td>Yes</td><td>No</td><td>Yes</td></tr>
<tr><td>6</td><td>Yes</td><td>Yes</td><td>No</td></tr>
<tr><td>7</td><td>Yes</td><td>Yes</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>A0</td><td>Air sensors still update atmospheric data but a new velocity of light compensation number is not calculated.</td></tr>
</table>

**Asterisk indicates commands that can be preceded by a numeric value. Also see additional comments that follow.*

3-47. HP-IB Bus Commands

3-48. Bus Commands can be UNIVERSAL COMMANDS, ADDRESSED COMMANDS, or UNADDRESSED COMMANDS. HP-IB compatible devices are designed to respond only to those Bus Commands that have useful meaning to them and to ignore all others. For example, a printer need not talk on the interface bus and could be designed to ignore all Bus Commands related to the talk function. The 5508A responds to a set of Bus Commands consisting of selected Universal Commands and Addressed Commands.

3-49. There are certain advantages to using Bus Commands instead of Instrument Function Codes but Bus Commands are not necessary for the 5508A. Programming Controllers to send Bus Commands requires less syntax than is required to send Instrument Function Codes. Also, program statements for Bus Commands are executed more quickly than those containing Instrument Function Codes and can also reduce Controller software requirements.

3-50. HP-IB Bus Commands and 5508A Responses

3-51. There are certain Bus Commands that are valid for the 5508A. Table 3-4, Valid Bus Commands lists these Bus Commands and 5508A responses. The 5508A must first be initialized to accept these Bus Commands. A program statement that accomplishes this should be included in the Controller software. The initializing statement will vary with different Controllers as will HP-IB control statements in general. In terms of the interface bus, the 5508A is initialized by setting the Single Line Command REMOTE ENABLE true (REN on Figure 3-9, HP-IB Structure) and addressing the 5508A to listen. After the 5508A is initialized for Bus Commands it will not respond to the front panel keys. The exception to this is the RESET key. The RESET key performs the HP-IB LOCAL function in addition to resetting the measurement. The HP-IB LOCAL function releases the instrument from bus control and therefore re-enables the keyboard.

Table 3-4. Valid Bus Commands

Addressed Commands		
Selected Device Clear	SCD	Clears HP-IB Output Buffer; VOL Compensation and Material Expansion/ Expansion/Contraction Compensation are Enabled if 10751A/B and 10757A/B/C are attached
Group Execute Trigger	GET	Triggers Data Output
Go To Local	GTL	Enables front panel keys
Universal Commands		
Device Clear	DCL	Same as for Selected Device Clear above
Local Lockout	LLO	Disables all Front Panel Keys including RESET

Table 3-5. HP-IB Capabilities

IEEE Function Code	Description
C0	No Controller Capability
T5	Basic Talker, Serial Poll, Talk Only Mode, Untalk If My Listen Address
L4	Basic Listener, No Listen Only Mode, Unlisten if My Talk Address
SH1	Source Handshake Capability
AH1	Acceptor Handshake Capability
SR1	Service Request Capability
RL1	Remote-Local Capability including Local Lock Out
PP0	No Parallel Poll Capability
DC1	Device Clear Capability
DT1	Device Trigger Capability
E1	Open Collector Outputs

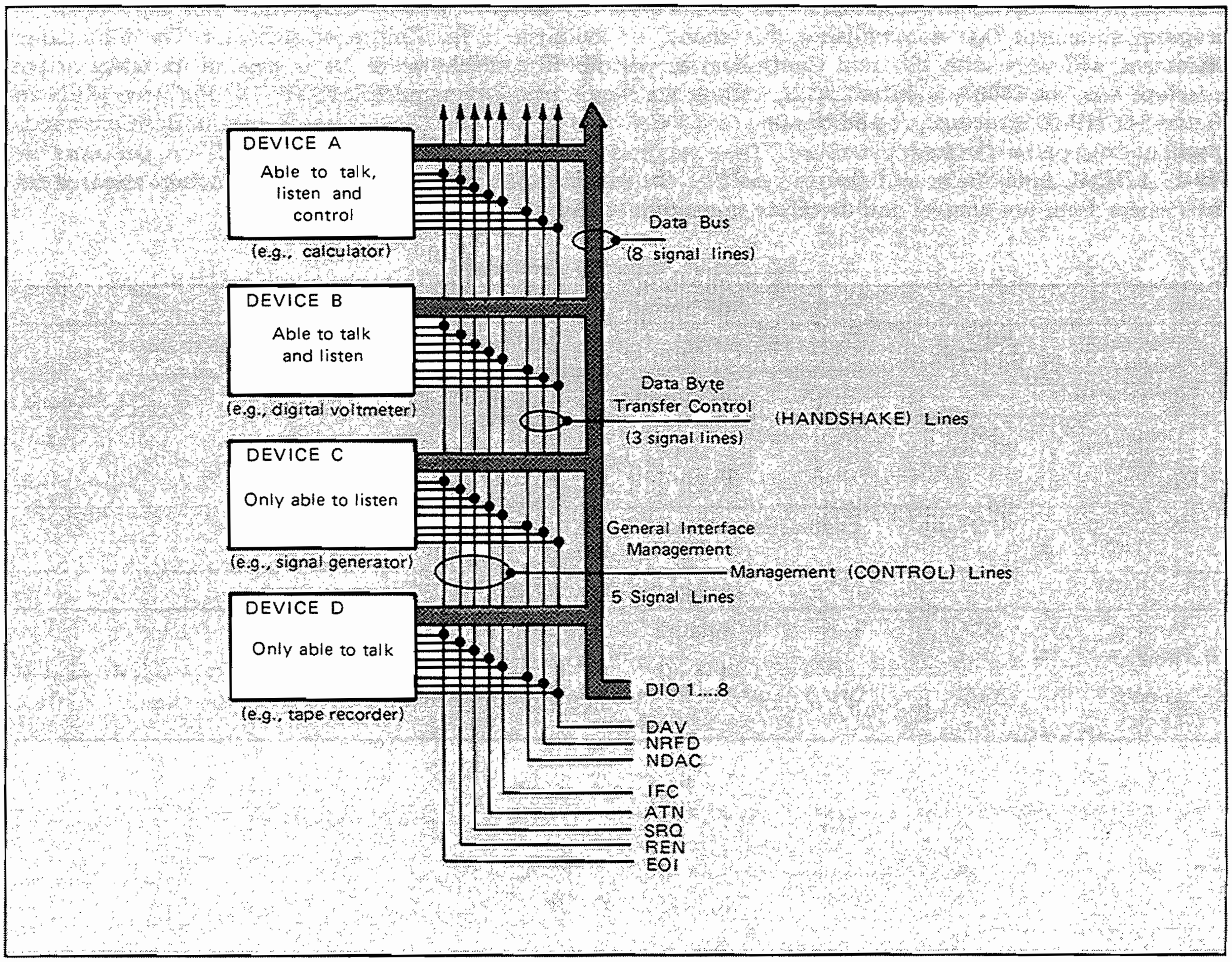

DEVICE A
Able to talk, listen and control
(e.g., calculator)
DEVICE B
Able to talk and listen
(e.g., digital voltmeter)
DEVICE C
Only able to listen
(e.g., signal generator)
DEVICE D
Only able to talk
(e.g., tape recorder)
Data Bus
(8 signal lines)
Data Byte Transfer Control
(3 signal lines)
(HANDSHAKE) Lines
General Interface Management
Management (CONTROL) Lines
5 Signal Lines
DIO 1....8
DAV
NRFD
NDAC
IFC
ATN
SRQ
REN
EOI

Figure 3-9. HP-IB Structure

3-52. Status Byte

3-53. An HP-IB Controller reads the status byte of the 5508A by executing an HP-IB serial poll. The status byte will return one of the following values. . . . .

Decimal		Displayed Error Message
0	Normal Operation	
65	Data Available for Output	
68, 69	Programming Error	Pr Error
70, 71	Underrange Error	Ur Error
72, 73	Overrange Error	Or Error
74, 75	Humidity Sensor Error (switch)	AH Error
76, 77	Pressure Transducer Error	AP Error
78, 79	Air Temp Sensor Error	AE Error
80, 81	MTS 3 Error	P3 Error
82, 83	MTS 2 Error	P2 Error
84, 85	MTS 1 Error	P1 Error
86, 87	Sample Rate Error (too high)	Sr Error
88, 89	Listener Error (too slow)	Lr Error
90, 91	Signal Error	SL Error
92, 93	Beam Path Error	PA Error
94, 95	Laser Head Error	Hd Error

NOTE

If multiple errors are present, only the highest value is output.

NOTE

The 5508A should be placed in a measurement mode before reading the status byte.

3-54. Clearing Error Conditions

3-55. Errors are cleared by correcting the condition then either by sending a reset (RS) for laser head errors, (Status Byte = 90, 91, 92, 93, 94, 95) or, for all other errors, sending any Instrument Function Code will clear the Error Message without loss of measurement data.

3-56. Output

3-57. Output may be obtained from the 5508A either by sending the Instrument Function Code RC, sending the HP-IB GROUP EXECUTE TRIGGER command (GET), or by using the AUTO RECORD key or the RECORD switch.

a. When the RC Instrument Function Code is used alone, measurement data will be unsmoothed.

b. When AUTO RECORD is initialized via HP-IB (Fixed Point Number)RC or from the front panel, the first sample will be unsmoothed and the rest will be smoothed.

c. The RECORD switch on the Remote Control Unit causes only smoothed data to be output.

d. Via HP-IB, the Bus Command GROUP EXECUTE TRIGGER (GET) or a DEVICE TRIGGER also yield smoothed data.

3-58. Sensor Errors

3-59. The 5508A will return a value of 999999999 whenever a controller requests a measurement reading from a sensor that is not plugged into the rear panel. Also, if a sensor is overranged the 5508A will return 111111111.

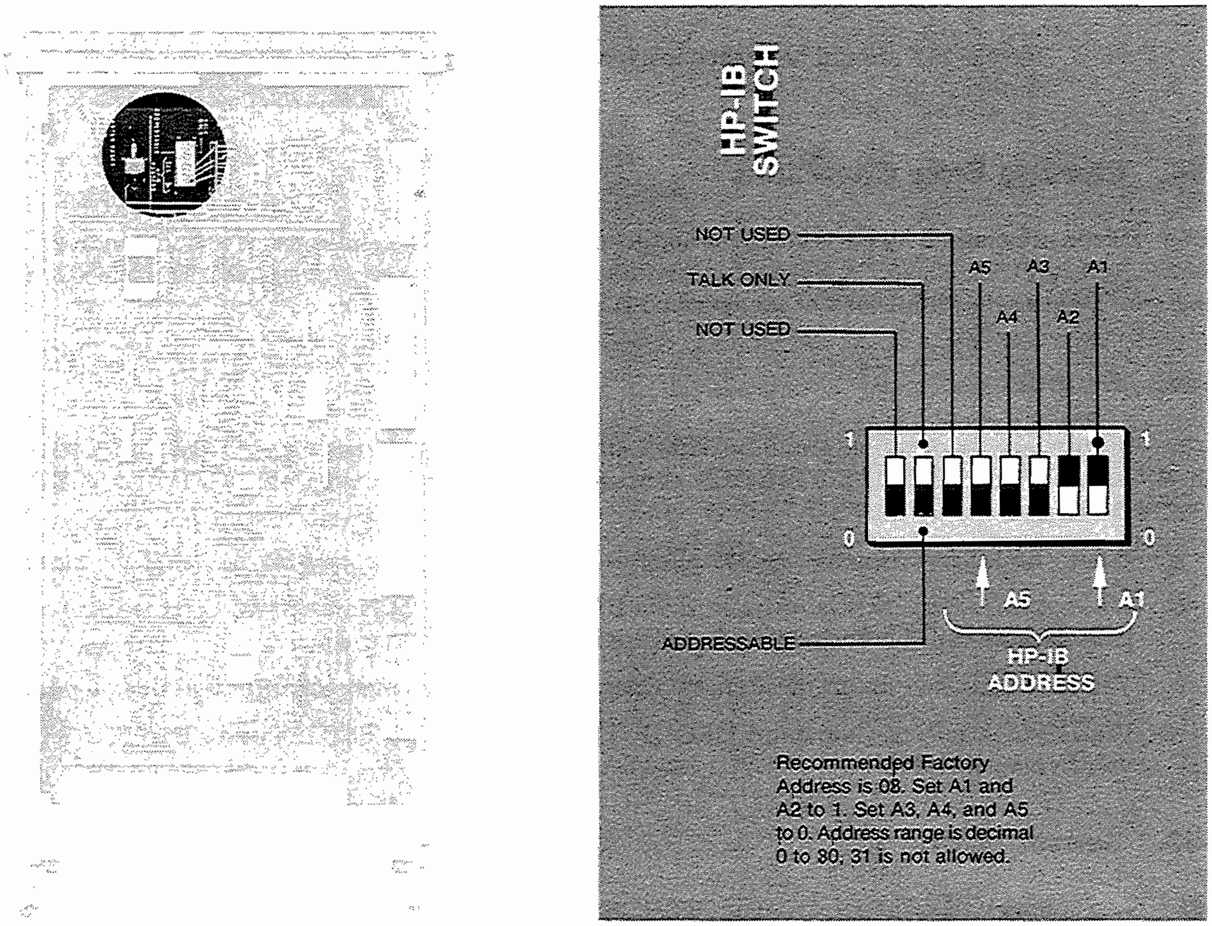
3-60. Interrupt Capability

3-61. The Single Line Command SERVICE REQUEST (SRQ in Figure 3-9) is sent by the 5508A on conditions which cause the status byte to assume a value greater than or equal to 65 decimal. This message can be utilized to implement interrupt driven routines in the Controller software.

3-62. HP-IB Switches

WARNING

BEFORE REMOVING THE 5508A TOP COVER AND CHECKING THE HP-IB SWITCH SETTING, REMOVE THE 5508A POWER CORD. IF THE POWER CORD IS CONNECTED TO THE 5508A, 100 TO 240 VOLTS AC MAY BE PRESENT EVEN WHEN THE FRONT POWER SWITCH IS SET TO OFF. CHECKING OR CHANGING THE HP-IB SWITCH SETTING SHOULD BE PERFORMED ONLY BY SERVICE TRAINED PERSONNEL WHO ARE AWARE OF THE HAZARDS INVOLVED (FOR EXAMPLE, FIRE AND ELECTRIC SHOCK).



Recommended Factory Address is 08. Set A1 and A2 to 1. Set A3, A4, and A5 to 0. Address range is decimal 0 to 30. 31 is not allowed.

Figure 3-10. HP-IB Address Switch

Table 3-6. HP-IB Addresses

Address (In decimal)	HP-IB Switch Settings A5 (16)	A4 (8)	A3 (4)	A2 (2)	A1 (1)
0	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
4	0	0	1	0	0
5	0	0	1	0	1
6	0	0	1	1	0
7	0	0	1	1	1
8	0	1	0	0	0
9	0	1	0	0	1
10	0	1	0	1	0
11	0	1	0	1	1
12	0	1	1	0	0
13	0	1	1	0	1
14	0	1	1	1	0
15	0	1	1	1	1
16	1	0	0	0	0
17	1	0	0	0	1
18	1	0	0	1	0
19	1	0	0	1	1
20	1	0	1	0	0
21	1	0	1	0	1
22	1	0	1	1	0
23	1	0	1	1	1
24	1	1	0	0	0
25	1	1	0	0	1
26	1	1	0	1	0
27	1	1	0	1	1
28	1	1	1	0	0
29	1	1	1	0	1
30	1	1	1	1	0
31	Not Allowed				

3-63. An 8-section DIP switch contains the HP-IB ADDRESS switches and the TALK ONLY-ADDRESSABLE switch. These are located on the 5508A Processor board (A2) just below the top cover. To gain access to these switches, disconnect primary power, loosen the screw at the back of the top cover and slide the cover rearward and remove. Figure 3-10 shows the HP-IB ADDRESS switch. The switch is factory set to 03 decimal (A1 and A2 switches set to 1). Allowable addresses are decimal 0 to decimal 30, decimal 31 is not allowed.

3-64. The TALK ONLY-ADDRESSABLE switch allows the instrument to output data in the TALK ONLY mode or to function as a Talker and Listener under the control of an HP-IB Controller in the ADDRESSABLE mode. For TALK ONLY operation, set the switch to 1, for ADDRESSABLE operation set the switch to 0. The switch is factory set to ADDRESSABLE.

3-65. OPERATOR'S MAINTENANCE

3-66. Operator's maintenance is limited to routines that can be accomplished without removing the instrument covers.

3-67. Fuses

WARNING

THE MAINS POWER FUSE IS DIFFERENT FOR 100-120V OPERATION AND 220-240V OPERATION. TO PROTECT THE INSTRUMENT FROM FIRE, REPLACEMENTS MUST BE OF THE SAME RATING AND TYPE.

3-68. The power line fuse is located in the power line module on the rear panel. To replace the fuse, proceed as follows:

a. On the 5508A, disconnect the power cable from the power line module.

b. Slide the clear plastic window to the left. Pull the small lever marked FUSE PULL outward from the power line module. Remove the fuse and note its value.

c. Push the FUSE PULL lever into the power line module before installing the fuse.

d. Insert the proper size fuse (marked on the rear panel) for the line voltage selected. Orient the fuse parallel to and near the top of the power module and push into place. Fuse values and part numbers are as follows:

100 to 120 Volt Lines — 2 Amp 250V Fast Blo Fuse HP P/N 2110-0002
198 to 240 Volt Lines — 1 Amp 250V Fast Blo Fuse HP P/N 2110-0001

e. Slide the plastic window to the right side of the power module.

3-69. Air Filter Cleaning

3-70. The air filter is located at the rear of the 5508A and should be cleaned periodically or when it has collected excessive dirt. To clean the filter proceed as follows:

a. On the rear panel of the 5508A, remove the posidrive screw on the right side of the filter holder. Pull the filter and filter holder away from the chassis. The filter element may be replaced by ordering HP Part No. 4208-0348.

b. Remove the filter from the holder and clean it by blowing compressed air through it from the inside out. If the filter is too dirty to clean with air, wash the filter element in hot water and a mild detergent. Dry the filter before reinstalling.

3-71. Procedures for Cleaning Measurement Optics

WARNING

THE FOLLOWING OPTICAL CLEANING PROCEDURES DO NOT APPLY TO THE OPTICS OF THE LASERS HEAD. CLEANING OF THE LASER HEAD OPTICS IS RARELY REQUIRED AND REQUIRES ACCESS TO THE INTERIOR OF THE INSTRUMENT WHERE HIGH VOLTAGES CAN BE PRESENT. ALL LASER HEAD MAINTENANCE SHOULD BE PERFORMED BY A QUALIFIED TECHNICIAN WHO IS AWARE OF THE HAZARDS INVOLVED.

3-72. If an Optical Instrument is visibly dirty on its optical surfaces, the following cleaning procedures should be used.

3-73. The optics should be handled with care so that nothing comes in contact with the exposed glass surfaces. Fingerprints will collect dust and dirt which will attenuate and disperse the laser beam. Cleaning the optics should be avoided unless the signal intensity of the beam is noticeably reduced as indicated by the BEAM STRENGTH meter.

3-74. If cleaning of the optics is required, be careful to avoid rubbing particles into the coated surfaces. Permanent reduction of signal intensity could result. If particles are observed on the optics surface, remove by blowing off with clean pressurized air or preferably dry nitrogen. If unavailable, commercially available products such as Kodak Laboratory Sprayer or Micro Duster TX600 from the Texwipe Company may be used. Each optical instrument is shipped with a package of lens tissue which is made specifically for cleaning optics. Use these tissues (or equivalent) with a pure industrial grade methanol in the following manner:

1. Fold the tissue into an approximate 1-inch square.
2. Wet the tissue with methanol (do not saturate) and gently wipe across optical surface. Use only enough pressure to remove the contaminant.
3. Do not reuse the tissue. For additional cleaning, repeat process with a new tissue.

3-75. For optical surfaces hard to reach, the tissue may be held with a clamping tweezer such as a hemostatic forcep. However, care must be taken to not scratch the coated surface.Do not scrub the surface with a dry tissue.

3-76. Avoid alcohol contamination with the following precautions:

a. Use only new, previously unopened containers. Alcohol absorbs water if left exposed to air. This will result in water spots when the alcohol evaporates.

b. Transfer the alcohol to a squeeze bottle that can be capped and made airtight.

c. Never transfer alcohol back into the original container.

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PERFORMANCE TESTS AND CALIBRATION

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SECTION IV
PERFORMANCE TESTS AND CALIBRATION

4-1. INTRODUCTION

4-2. This section contains performance tests and calibration procedures for the 5528A Laser Measurement system. A test record is included to record calibration results for future comparison.

4-3. SAFETY CONSIDERATIONS

4-4. The following warning contains information that must be understood for your safety.

WARNING

MAINTENANCE DESCRIBED HEREIN IS PERFORMED WITH POWER SUPPLIED TO THE INSTRUMENT, AND PROTECTIVE COVERS REMOVED. 100 VOLTS TO 240 VOLTS AC MAY BE PRESENT IN THE 5508A EVEN WHEN THE FRONT PANEL POWER SWITCH IS SET TO OFF. MAINTENANCE SHOULD BE PERFORMED ONLY BY SERVICE-TRAINED PERSONNEL WHO ARE AWARE OF THE HAZARDS INVOLVED (FOR EXAMPLE, FIRE AND ELECTRIC SHOCK). WHERE MAINTENANCE CAN BE PERFORMED WITHOUT POWER APPLIED, THE POWER CORD SHOULD BE REMOVED.

4-5. RECOMMENDED TEST EQUIPMENT

4-6. Test equipment required for the performance tests and calibration procedures are included in the procedures. Detailed critical specifications for the required test equipment are contained in Table 1-4, Recommended Test Equipment. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

4-7. TEST RECORD

4-8. Results of the performance tests and calibration procedures may be tabulated on the test record in Table 4-3.

4-9. 5528A PERFORMANCE TESTS

4-10. The Operator's Check listed in Section III can be used as a performance test of the 5528A System. The Operator's check is sufficient for incoming inspection and periodic and post repair verification. The results of the Operator's checks at incoming inspection can be used for comparison in periodic maintenance and troubleshooting.

4-11. 5508A PERFORMANCE TESTS

4-12. The 5508A self-test that is automatically performed at power-up extensively checks the following 5508A circuitry:

a. Read-Only Memory

b. Read/Write Memory

c. Measurement and Reference Signal Counter Circuits

d. A/D Converter Subsystem

4-13. Refer to Paragraph 3-28, Self-Test and Warm-Up Countdown, to verify proper self-test execution.

4-14. 5518A PERFORMANCE TESTS

4-15. The 5518A performance tests include a laser power output test and a measurement receiver gain test.

4-16. Laser Power Output Test

4-17. Test Equipment Required. The following test equipment is required to test the laser output power.

Laser Power Meter, Graseby Optronics, Model 351L (Phone 407 282-1408)

4-18. Procedure

a. Connect the 5508A to the 5518A using Interconnect cable HP Part Number 10793A/B/C. Connect one end to the 5508A rear panel jack marked LASER SOURCE, connect the other end to the 18-pin connector on the rear panel of the 5518A.

b. On the 5518A, set the turret to OTHER. Set the exit shutter of the turret assembly to its open aperture position.

c. On the 5508A, set the Line switch to ON and wait until the 5508A displays PA Error. If the 5508A fails self test or the warm-up countdown does not terminate with PA Error, see 5528A Block Diagram and System Troubleshooting in Section VIII.

d. Using the Laser Meter, align the power meter detector for maximum reading.

e. If the laser power output is less than 100 microwatts, see Laser High Voltage Troubleshooting in Section VIII-C.

f. Leave power applied and continue to the receiver gain test.

4-19. Receiver Gain Test

4-20. The receiver gain test should only be performed after the Laser Power Output Test, Paragraph 4-16, has been successfully completed.

4-21. Test Equipment Required. The following test equipment is required to test the receiver gain:

Retroreflector, HP Model 10767A
Optical Attenuator, HP Part Number 1000-0598

Additional Equipment for Convenience

Height Adjuster and Post, HP Model 10785A
Base, HP Model 10784A

4-22. Procedure

a. Position the 10767A Retroreflector in the beam path at a maximum distance of 6 inches from the laser turret assembly and align the return beam for maximum indication on the 5508A beam strength meter. Place a piece of white card stock in the return beam path. If there is a dark line in the beam, rotate the 10767A 90°.

b. Remove the card stock. On the 5508A, press RESET.

c. The 5508A should display 0.00000 inches. If not, check the rear panel ENGLISH/METRIC switch position and see 5528A Block Diagram and Troubleshooting Procedure in Section VIII.

d. Place optical attenuator, HP Part Number 1000-0598, in either the exit or return laser beam path, but not both. Realign return beam for maximum reading on the beam strength meter. Observe that the SIGNAL LED remains lighted. If not, see Paragraph 5-11, Receiver Gain Adjustment.

4-23. 10751A/B AND 10757A/B/C PERFORMANCE TESTS

4-24. Performance Tests for the 10751A/B Air Sensor and the 10757A/B/C Material Temperature Sensor require the same equipment as is recommended for calibration. Tests for performance verification are described as part of the calibration procedure for each instrument.

4-25. CALIBRATION CYCLE

3

4-26. The 5528A System requires periodic calibration. The 5508A, 10751A/B, 10757A/B/C should be calibrated using the following procedures every 12 months or when required because of repair. The 5518A does not require calibration. It is recommended that the 10751A/B and 10757A/B/C be returned to Hewlett-Packard for calibration.

4-27. 5508A CALIBRATION PROCEDURES

NOTE

> 5508A calibration is only necessary for 5528A Systems that use the 10751A/B Air Sensor or the 10757A/B/C Material Temperature Sensor.

4-28. The calibration procedures for the 5508A consist of calibrating the +10V and +0.5V internal voltage references. These are performed with the 5518A, 10751A/B, and 10757A/B/C disconnected.

4-29. The 5508A Voltage References are used for Analog to Digital Conversion of the 10751A/B and 10757A/B/C signals. For detailed operation verification, an A/D accuracy test located in Section VIII can be used.

4-30. Test Equipment Required. The following test equipment is required for these procedures:

Digital Voltmeter, HP Model 3456A
Calibration Label, HP Part Number 7121-2013

4-31. Preliminary Procedures

NOTE

When calibrating the 5508A, the unit must be operated at an ambient temperature between 18°C and 27°C.

a. Set the 3456A Digital Voltmeter controls as follows:

FUNCTION to DC Volts

AUTO ZERO to ON

FILTER to OFF

N DIG DISP = 6 (provides 10 microvolt resolution during +10Vref calibration and 1 microvolt resolution during +0.5Vref calibration.

N CYC INT = 10 (integration period = 10 power line cycles)

b. Remove the top cover of the 5508A.

CAUTION

Avoid finger contact with components and pc board in the vicinity of A3U65. Contamination may effect A/D Converter accuracy.

c. On the 5508A, set the LINE switch to ON and wait until the 5508A displays LASr FAIL. If the 5508A fails its self-test or the warm-up countdown does not terminate with LASr FAIL, check set-up and see 5528A Block Diagram and System Troubleshooting in Section VIII.

4-32. +10Vref Calibration Procedure

a. Connect positive lead of DVM to test point A3TP40, marked +10VR and the negative lead to test point A3TP39 marked AG, for Analog Ground on the 5508A A3 Board.

b. The voltage indicated on the DVM should be 10V ±10 millivolts. If not, check setup and see +10Vref Troubleshooting in Section VIII. Record the measured voltage on line 3, +10Vref, of the Test Record, Table 4-3.

c. Using a calculator, compute the following:

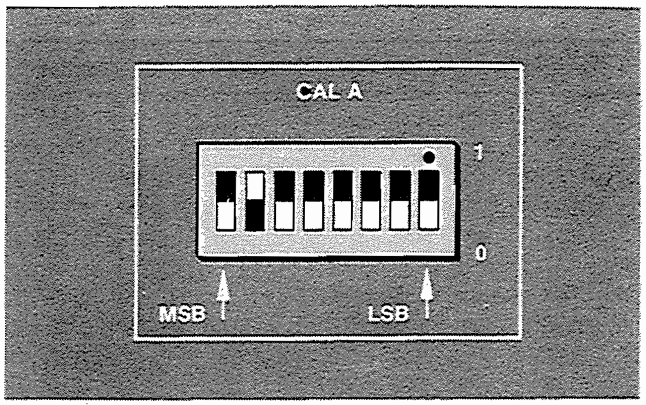
$$(V-9.98976) \times 12500$$

where V = voltage measured by the DVM

d. Round the calculated value to an integer and enter that number in binary form on the 8-bit switch, A3S1, marked "CAL A" on the 5508A Counter Board A3. Refer to Table 4-1 for the binary value that corresponds to the decimal number obtained in the computation.

EXAMPLE

Assume the voltage read was 10.00500 Volts. Using the formula above (10.005 - 9.98976 × 12500 = 190.5. Round this off to 191. Converted to binary, 191 equals 10111111. This binary value would be entered into A3S1 as shown.



e. Enter value for CAL A (decimal) on calibration label and attach to the 5508A rear panel next to the serial number plate. The CAL A value can also be recorded on the Test Record, Table 4-3.

Table 4-1. Converting Decimal Numbers to Binary Format

Decimal	Binary	Decimal	Binary	Decimal	Binary	Decimal	Binary
0	00 000 000	30	00 011 110	60	00 111 100	90	01 011 010
1	00 000 001	31	00 011 111	61	00 111 101	91	01 011 011
2	00 000 010	32	00 100 000	62	00 111 110	92	01 011 100
3	00 000 011	33	00 100 001	63	00 111 111	93	01 011 101
4	00 000 100	34	00 100 010	64	01 000 000	94	01 011 110
5	00 000 101	35	00 100 011	65	01 000 001	95	01 011 111
6	00 000 110	36	00 100 100	66	01 000 010	95	01 100 000
7	00 000 111	37	00 100 101	67	01 000 011	97	01 100 001
8	00 001 000	38	00 100 110	68	01 000 100	98	01 100 010
9	00 001 001	39	00 100 111	69	01 000 101	99	01 100 011
10	00 001 010	40	00 101 000	70	01 000 110	100	01 100 100
11	00 001 011	41	00 101 001	71	01 000 111	101	01 100 101
12	00 001 100	42	00 101 010	72	01 001 000	102	01 100 110
13	00 001 101	43	00 101 011	73	01 001 001	103	01 100 111
14	00 001 110	44	00 101 100	74	01 001 010	104	01 101 000
15	00 001 111	45	00 101 101	75	01 001 011	105	01 101 001
16	00 010 000	46	00 101 110	76	01 001 100	106	01 101 010
17	00 010 001	47	00 101 111	77	01 001 101	107	01 101 011
18	00 010 010	48	00 110 000	78	01 001 110	108	01 101 100
19	00 010 011	49	00 110 001	79	01 001 111	109	01 101 101
20	00 010 100	50	00 110 010	80	01 010 000	110	01 101 110
21	00 010 101	51	00 110 011	81	01 010 001	111	01 101 111
22	00 010 110	52	00 110 100	82	01 010 010	112	01 110 000
23	00 010 111	53	00 110 101	83	01 010 011	113	01 110 001
24	00 011 000	54	00 110 110	84	01 010 100	114	01 110 010
25	00 011 001	55	00 110 111	85	01 010 101	115	01 110 011
26	00 011 010	56	00 111 000	86	01 010 110	116	01 110 100
27	00 011 011	57	00 111 001	87	01 010 111	117	01 110 101
28	00 011 100	58	00 111 010	88	01 011 000	118	01 110 110
29	00 011 101	59	00 111 011	89	01 011 001	119	01 110 111

(Continued)

Table 4-1. Converting Decimal Numbers to Binary Format (Continued)

Decimal	Binary	Decimal	Binary	Decimal	Binary	Decimal	Binary
120	01 111 000	154	10 011 010	188	10 111 100	222	11 011 110
121	01 111 001	155	10 011 011	189	10 111 101	223	11 011 111
122	01 111 010	156	10 011 100	190	10 111 110	224	11 100 000
123	01 111 011	157	10 011 101	191	10 111 111	225	11 100 001
124	01 111 100	158	10 011 110	192	11 000 000	226	11 100 010
125	01 111 101	159	10 011 111	193	11 000 001	227	11 100 011
126	01 111 110	160	10 100 000	194	11 000 010	228	11 100 100
127	01 111 111	161	10 100 001	195	11 000 011	229	11 100 101
128	10 000 000	162	10 100 010	196	11 000 100	230	11 100 110
129	10 000 001	163	10 100 011	197	11 000 101	231	11 100 111
130	10 000 010	164	10 100 100	198	11 000 110	232	11 101 000
131	10 000 011	165	10 100 101	199	11 000 111	233	11 101 001
132	10 000 100	166	10 100 110	200	11 001 000	234	11 101 010
133	10 000 101	167	10 100 111	201	11 001 001	235	11 101 011
134	10 000 110	168	10 101 000	202	11 001 010	236	11 101 100
135	10 000 111	169	10 101 001	203	11 001 011	237	11 101 101
136	10 001 000	170	10 101 010	204	11 001 100	238	11 101 110
137	10 001 001	171	10 101 011	205	11 001 101	239	11 101 111
138	10 001 010	172	10 101 100	206	11 001 110	240	11 110 000
139	10 001 011	173	10 101 101	207	11 001 111	241	11 110 001
140	10 001 100	174	10 101 110	208	11 010 000	242	11 110 010
141	10 001 101	175	10 101 111	209	11 010 001	243	11 110 011
142	10 001 110	176	10 110 000	210	11 010 010	244	11 110 100
143	10 001 111	177	10 110 001	211	11 010 011	245	11 110 101
144	10 010 000	178	10 110 010	212	11 010 100	246	11 110 110
145	10 010 001	179	10 110 011	213	11 010 101	247	11 110 111
146	10 010 010	180	10 110 100	214	11 010 110	248	11 111 000
147	10 010 011	181	10 110 101	215	11 010 111	249	11 111 001
148	10 010 100	182	10 110 110	216	11 011 000	250	11 111 010
149	10 010 101	183	10 110 111	217	11 011 001	251	11 111 011
150	10 010 110	184	10 111 000	218	11 011 010	252	11 111 100
151	10 010 111	185	10 111 001	219	11 011 011	253	11 111 101
152	10 011 000	186	10 111 010	220	11 011 100	254	11 111 110
153	10 011 001	187	10 111 011	221	11 011 101	255	11 111 111

4-33. +0.5Vref Calibration

4-34. The +0.5 Volt reference should only be calibrated after the +10 Volt reference calibration procedure has been properly completed.

4-35. Procedure

a. Move the positive lead of the DVM from +10Vref test point to A3U65 pin 36, +0.5Vref. The voltage indicated by the DVM should be equal to 0.5 Volt ±1.25 millivolts. If not check setup and see +0.5Vref Troubleshooting in Section VIII.

b. Note DVM reading of 0.5 Vref and find the reading, ±40 microvolts, in Table 4-2. Set the CAL B switches with the corresponding binary value. Enter the value for CAL B (decimal) on the TEST RECORD, Table 4-3.

EXAMPLE

Assume the DVM indicates 0.498835 Volt. From Table 4-2, 0.498800 Volt is the nearest value. The corresponding binary number, 00001, would be entered into the CAL B switches, part of A3S2, as shown below.

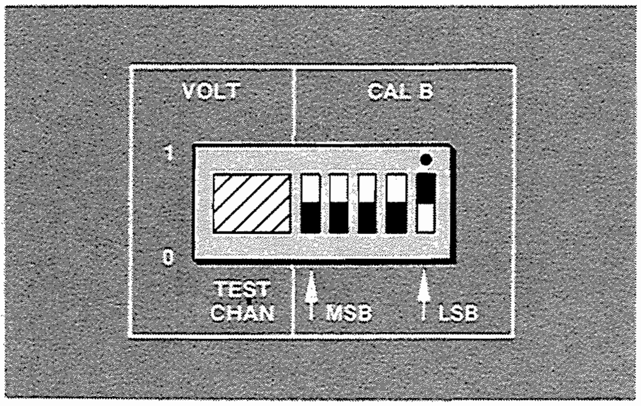


Table 4-2. ±0.5 Vref Calibration Table

V (Volts)	Cal B (Decimal)	Cal B (Binary)
0.498720	0	00000
0.498800	1	00001
0.498880	2	00010
0.498960	3	00011
0.499040	4	00100
0.499120	5	00101
0.499200	6	00110
0.499280	7	00111
0.499360	8	01000
0.499440	9	01001
0.499520	10	01010
0.499600	11	01011
0.499680	12	01100
0.499760	13	01101
0.499840	14	01110
0.499920	15	01111
0.500000	16	10000
0.500080	17	10001
0.500160	18	10010
0.500240	19	10011
0.500320	20	10100
0.500400	21	10101
0.500480	22	10110
0.500560	23	10111
0.500640	24	11000
0.500720	25	11001
0.500800	26	11010
0.500880	27	11011
0.500960	28	11100
0.501040	29	11101
0.501120	30	11110
0.501200	31	11111

NOTE

The 5508A reads the calibration switches only at power-up, therefore, calibration switch changes will not affect 5508A operation until A.C. power has been cycled and the 5508A executes its self-test. Alternatively, the 5508A MASTER RESET, A2S2, can be toggled to cause the 5508A to read the new switch settings without turning power off.

4-36. 10751A CALIBRATION PROCEDURES

4-37. Due to the complexity of the calibration procedures and the test equipment required, it is recommended that the 10751A/B be returned to Hewlett-Packard for calibration.

4-38. The 10751A/B Pressure and Temperature circuitry both require a 12 month calibration cycle. Also calibration should be performed after repair is made to any of the 10751A/B circuits except the humidity switch circuit.

4-39. Equipment Required. Refer to Table 1-4 in Section I for a list of test equipment required for the 10751A/B calibration procedures. In addition, the procedures require the 5508A Measurement Display and a HP 3456A Digital Voltmeter. Also for convenience, the following additional equipment is recommended:

Accessories for Temperature Calibration

*Extender Cable, (10751-60201/60202 to 10751-60001)
*Extender Cable, (10751-60001 to 10751-60002)

Accessories for Pressure Calibration

*Extender Cable, (10751-60201/60202 to 10751-60001)
*Adaptor, (1/4 inch I.D. Pneumatic Hose to 10751A/B Pressure Transducer)

These items are available from HP by ordering Model #K16-59995A.

WARNING

MAINTENANCE DESCRIBED HEREIN IS PERFORMED WITH POWER SUPPLIED TO THE INSTRUMENT, AND PROTECTIVE COVERS REMOVED. 100 VOLTS TO 240 VOLTS AC MAY BE PRESENT IN THE 5508A EVEN WHEN THE FRONT PANEL POWER SWITCH IS SET TO OFF. MAINTENANCE SHOULD BE PERFORMED ONLY BY SERVICE-TRAINED PERSONNEL WHO ARE AWARE OF THE HAZARDS INVOLVED (FOR EXAMPLE, FIRE AND ELECTRIC SHOCK). WHERE MAINTENANCE CAN BE PERFORMED WITHOUT POWER APPLIED, THE POWER CORD SHOULD BE REMOVED.

CAUTION

The 10751A/B circuitry is susceptible to damage from electrostatic discharge, therefore use an anti-static work station and ground straps when handling printed circuit assemblies during assembly or disassembly.

4-40. Temperature Calibration Procedure

4-41. The air temperature transducer calibration is performed with the temperature transducer assembly, 10751-60002, immersed in a temperature controlled bath at 20°C ±1°C.

NOTE

The 10751-60002 should only be immersed in dielectric liquid, Flourinet FC-40 or equivalent. The 10751-60002 should not be immersed in water.

4-42. The equipment in Table 1-4 should be configured to form the system depicted in Figure 4-1.

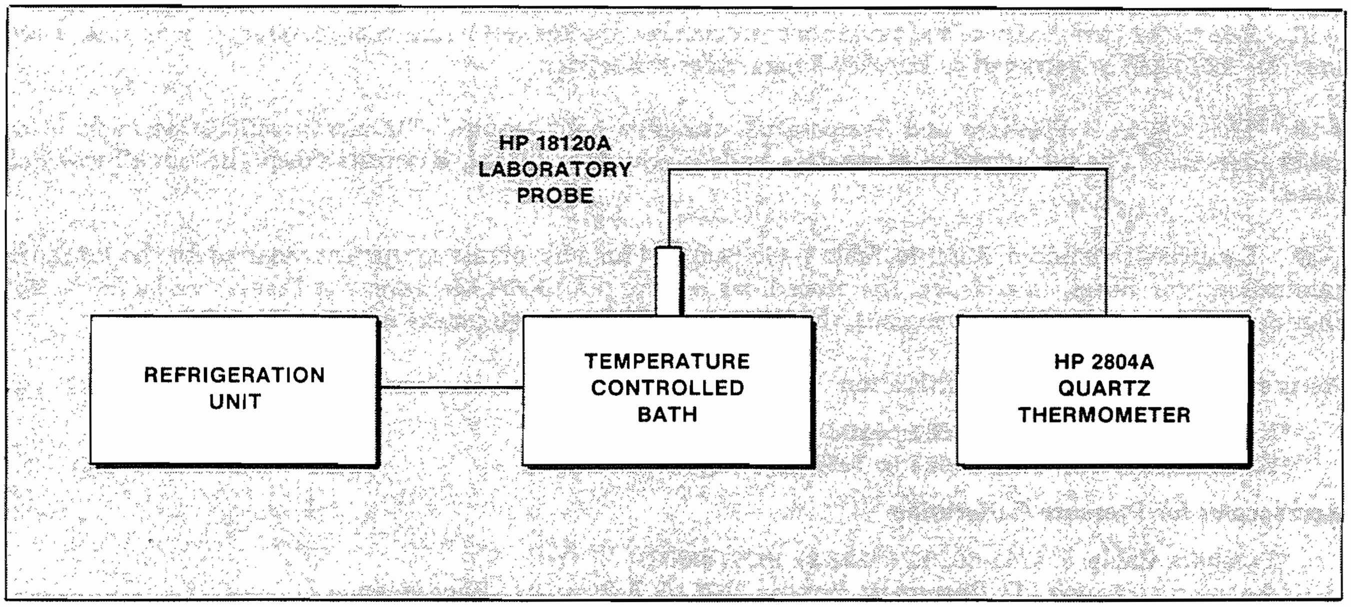


Figure 4-1. 10751A/B Temperature Calibration Test System Configuration

a. On the 10751A/B, remove the label on the humidity switch side of the housing.

b. Remove the pozi-drive screws located beneath the label.

c. Carefully remove the 10751A/B cover noting how the printed circuit boards are mounted between the cover and the cable assembly.

d. Detach the 10751-60001 board from the cable assembly. Check that the key is inserted in the unused contact of the cable assembly connector corresponding to the missing pin on the 10751-60001 plug.

e. Inspect cable and connectors for damage.

f. Install extension cable HP Part Number 10751-60204 between cable assembly and 10751-60001.

g. Secure 10751-60001 such that power can be applied and the TEMP potentiometer, A1R1, can be adjusted.

h. Install extension cable HP Part Number 10751-60203 between 10751-60001 board and 10751-60002 board.

i. Immerse 10751-60002 board in the bath in close proximity to the quartz thermometer probe without resting either on the inside of the bath housing.

j. Connect 10751 cable assembly to 5508A rear panel connector marked AIR SENSOR.

k. On the 5508A rear panel, set the ENGLISH/METRIC switch to METRIC.

l. Connect the positive lead of the DVM to test point A3TP40, marked +10VR, and the negative lead to test point A3TP39 marked AG, for Analog Ground on the 5508A A3 Board.

m. Plug 5508A into AC outlet and set the LINE switch to ON.

n. Wait until the 5508A goes through its warm-up countdown sequence and the display flashes LASr FAIL. If the 5508A fails its self test or the warm-up countdown does not end with LASr FAIL, check setup and see 5528A Block Diagram and System Troubleshooting in Section VIII.

o. Monitor the quartz thermometer to be sure that the bath temperature is stable at 20°C ±1°C to within 0.03°C for a 1 minute period.

p. Note the value of +10Vref indicated by the DVM. The measured value should be +10V ±10 millivolts. If not, check set-up and see +10Vref Troubleshooting in Section VIII. Record the value of +10Vref for use in step r.

q. Connect floating negative terminal of DVM to test point TP39, marked AG on 5508A A3 and positive terminal of DVM to pin 5 of A3R56.

r. Note the reading of the quartz thermometer (in °C) and calculate the adjustment voltage, V, as follows:

$$V = 0.87502 - (0.0335 \times T) + dV$$

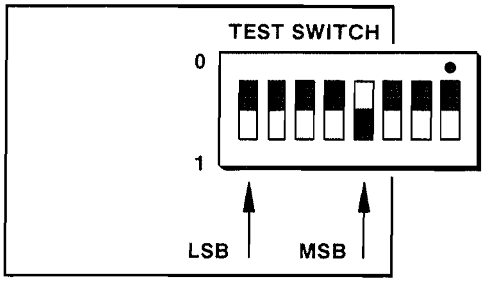
where: T is the reading of the quartz thermometer and $dV = +10Vref-10$.

s. Adjust TEMP potentiometer, A1R1, such that the DVM reading equals V from step r ±250 microvolt.

t. The accuracy of the 10751A/B temperature measurement can be checked using the quartz thermometer and stable bath temperatures within the operating range of the 10751A/B, 0 to 40°C.

Procedure

1. Perform the 5508A Calibration Procedures, Paragraph 4-27 through 4-35.
2. Set 5508A Test Switches A2S3 to 0001 0000 and toggle the 5508A Master Reset switch A2S2.



3. Press V.O.L. twice on 5508A front panel to display.

E XX.XX C

where XX.XX is the temperature measured by the 10751A/B temperature transducer.

4. The bath temperature can now be adjusted to various temperatures within the range of 0 to 40°C in order to verify temperature measurement specifications of the 10751A/B. The reading of the quartz thermometer should be allowed to stabilize at each selected temperature to within ±0.03°C for 1 minute before comparing the reading to that on the 5508A display. An offset of +0.76°C should be added to the 5508A display for comparison purposes. Adding this offset corrects for the fact that bath temperature instead of air temperature is being measured by the 10751A/B temperature sensor.
5. If any reading within the operating range indicates measurement error outside the accuracy specification of the 10751A/B, the temperature transducer assembly, 10751-60002, should be replaced and the calibration procedure repeated.

u. Turn 5508A AC power off.

v. Remove 10751-60002 from the bath and allow to dry.

w. Disconnect 10751A/B and reassemble or continue with pressure calibration.

4-43. Air Pressure Calibration Procedure

4-44. The equipment listed in Table 1-4 should be configured to form the system depicted in Figure 4-2.

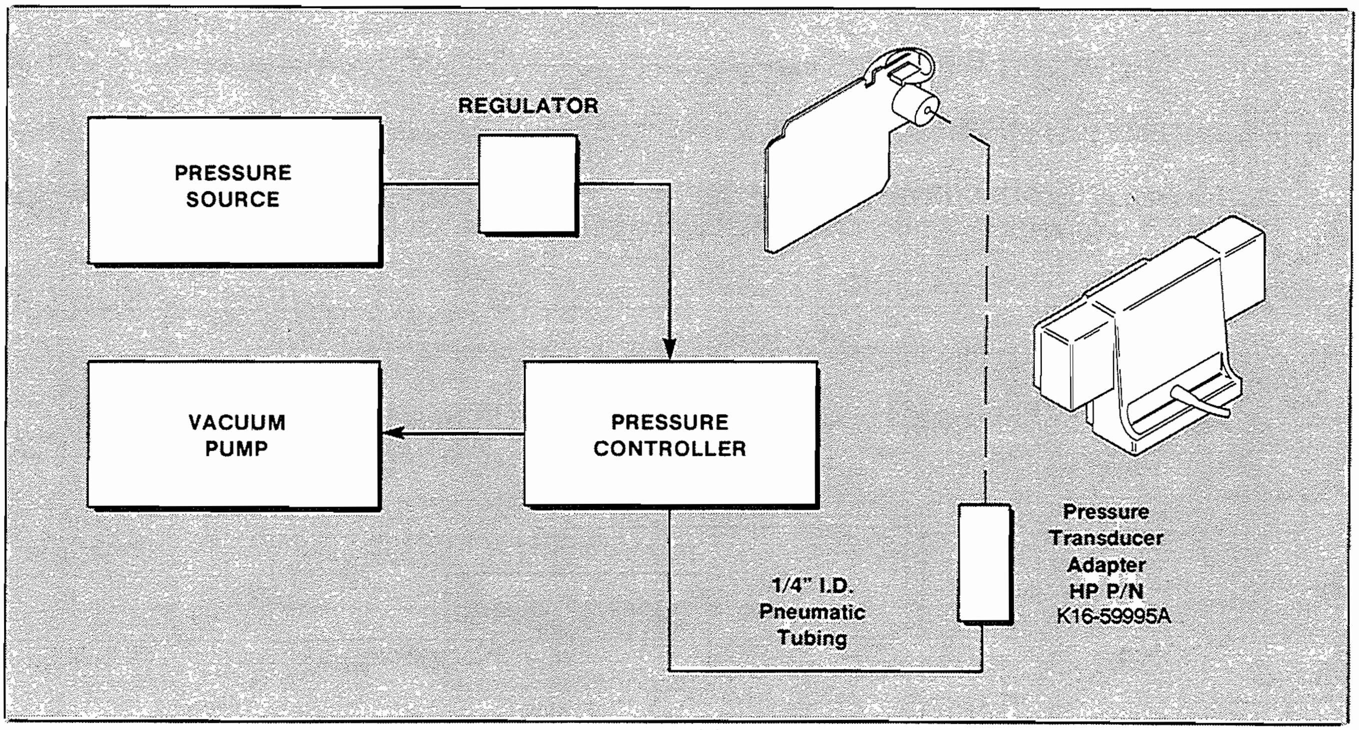

REGULATOR
PRESSURE SOURCE
VACUUM PUMP
PRESSURE CONTROLLER
1/4" I.D. Pneumatic Tubing
Pressure Transducer Adapter HP P/N K16-59995A

Figure 4-2. 10751A/B Air Pressure Calibration Test System Configuration

a. On the 10751A/B, remove the label on the humidity switch side.

b. Remove the pozi-drive screws located beneath the label.

c. Carefully remove the 10751A/B cover noting how the printed circuit boards are mounted between the cover and the cable assembly.

d. Detach cable assembly from the 10751-60001 board. Check that the key is inserted in the unused contact of the cable assembly corresponding to the missing pin on the 10751-60001 connector.

e. Inspect cable and connectors for damage.

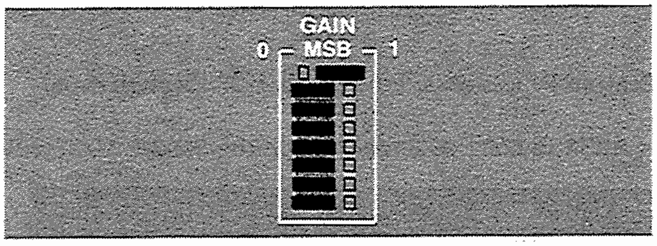
f. Install extension cable HP Part Number 10751-60204 between cable assembly and 10751-60001.

CAUTION

Do not expose the 10751A/B Air Pressure Transducer A2U1 to pressures outside its operating range 517 to 776.5 mm Hg.

g. Secure the 10751-60001 board such that power can be applied and the GAIN and OFFSET jumpers can be adjusted.

h. On the 10751-60001 board, turn GAIN potentiometer, A1R8, fully clockwise. Set the pressure calibration GAIN jumpers to the position shown below.



i. Attach pressure controller to 10751A/B pressure transducer, 10751-60303, using Adaptor, HP Part Number 10751-20005 and 1/4 inch I.D. pneumatic tubing.

NOTE

The pressure transducer cylinder axis must be horizontal during calibration.

j. Attach 10751A/B to 5508A rear ~~panel~~ connector marked AIR SENSOR.

k. On 5508A rear panel, Set ENGLISH/METRIC switch to METRIC.

l. Remove 5508A top cover.

m. Connect the 5508A power cable to an AC main and set the LINE switch to ON.

n. Connect floating negative terminal of the DVM to test point, A3TP39, marked AG on 5508A A3. Connect positive terminal of DVM to A3R56 pin 5.

o. Wait for 30 minutes with power applied to the 5508A and 10751A/B.

NOTE

Steps p through s are to be performed for each GAIN jumper in descending order. At this time the MSB jumper should already be set to 1 and all others to 0.

p. Set pressure controller such that pressure applied to 10751A/B pressure transducer is 517 mm Hg ±0.1 mm Hg and write down the voltage indicated by the 3456A. This voltage will be referred to as Vap(517) in step r.

q. Set pressure controller to 775.5 ±0.1 mm Hg and write down the voltage indicated by the 3456A. This voltage will be referred to as Vap(775.5) in step r.

r. If Vap(517) - Vap(775.5) >1.0106 Volts, then leave the jumper at 1.

If Vap(517) - Vap(775.5) <1.0106 Volts, then set the jumper from 1 to 0.

s. Place next GAIN jumper to 1 from 0.

t. Repeat steps p through s for each GAIN jumper.

u. Adjust GAIN potentiometer A1R8 such that

Vap(517) - Vap(755.5) = 1.0106 Volts ±200 microvolts

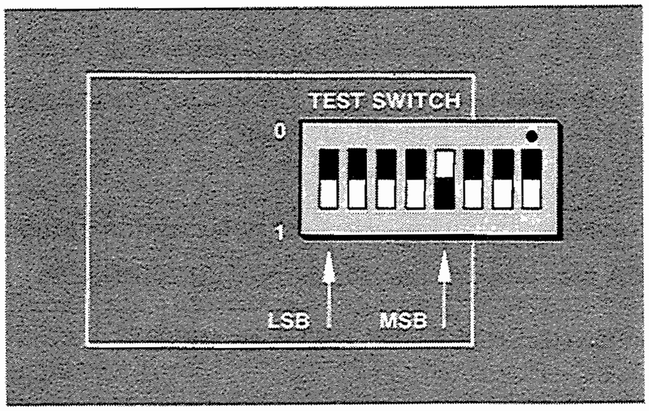
v. Adjust OFFSET jumpers such that Vap = 0.0000 V ±200 microvolts at a controller pressure of 760.2 ±0.1 mm Hg.

w. The 10751A/B pressure measurement accuracy can be verified by using the pressure controller to check the 10751A/B pressure measurement within the operating range of the 10751A/B, 517 to 775.5 mm Hg.

Procedure

1. Perform the 5508A Calibration Procedures, Paragraph 4-27 through 4-35.

2. Set 5508A Test Switches A2S3 to 0001 0000 and toggle the 5508A Master Reset switch A2S2.



The 5508A display should read 0.0000 mm, if not check A2S3 switch setting and see 5528A Block Diagram and System Troubleshooting.

3. On 5508A, press V.O.L. 3 times to display

P XX.XX

where XX.XX is the pressure measured by the 10751A/B in mm of Hg.

4. The pressure controller can now be adjusted to various pressures within the range of 517 to 775.5 mm Hg in order to verify pressure measurement specifications of the 10751A/B.

5. If any reading within the operating range indicates measurement error outside the accuracy specification of the 10751A/B, the pressure transducer assembly, HP Part Number 10751-60303 should be replaced and the calibration procedure repeated.

x. Turn 5508A AC power off.

y. Disconnect the test setup and reassemble the 10751A/B.

4-45. 10757A/B/C CALIBRATION MATCHING PROCEDURES

4-46. This procedure tailors the output characteristics of the 10757A/B/C Material Temperature Sensor to exactly match a particular 5508A Measurement Display. This allows an improvement in material temperature measurement accuracy to 0.1°C over an operating range of 0°C to 40°C. To adjust the sensors, proceed as follows:

a. Remove the four screws holding the two case halves together. Carefully separate the two case halves, leaving the printed circuit board and cable boots in place in the bottom half (see Figure 6-11).

b. Remove DIP jumper JB1 and replace with a jumper HP Part Number 1810-0520.

c. Connect the 5508A (to which the 10757A/B/C is to be matched) to primary ac power. Set the LINE switch to ON and observe the 5508A display fro the CAL A number. The display will appear as "CAL A xxx", where xxx is the CAL A number. Record this number for use in the next step. Set the 5508A LINE switch to OFF.

d. Referring to Table 4-1, findthe binary equivalent of the CAL A number determined tin step c. This binary number will be entered into the 10757A/B/C's calibration match DIP jumper.

e. Starting with the most significant digit (MSB), punch out each portion ofthe DIP jumper which corresponds to a "1" in the binary CAL A number.

EXAMPLE

If CAL A was 78 (01 001 110 binary), the cal match DIP jumper should appear as follows after punching the appropriate holes.

Close 0 U
Open 1 P
Close 0 U
Close 0 U
Open 1 P
Open 1 P where U is an unpunched conductor and
Open 1 P P is a punched (broken) conductor.
Close 0 U

f. Replace the top case cover and install the four case screws. Using a permanent marking pen, record the CAL A value on the calibration label.

g. Repeat the calibration match process for other 10757A/B/C's to be used with the same 5508A Measurement Display.

4-47. 10757A/B/C CALIBRATION PROCEDURES

4-48. Due to the complexity of the calibration procedures and test equipment required, it is recommended that the 10757A/B/C be returned to Hewlett-Packard for periodic calibration.

4-49. The 10757A/B/C temperature circuitry requires a 12 month calibration cycle. Also calibration should be performed after repair is made to any of the 10757A/B/C circuits.

4-50. Equipment Required. Refer to Table 1-4 in Section I for a list of test equipment required for the 10757A/B/C calibration procedures. In addition, the procedures require the 5508A Measurement Display and an HP 3456A Digital Voltmeter. If a 2804A Quartz Thermometer is used, it should have been checked at ice point within the previous 3 months. Glass thermometers should be checked at ice point just prior to performing the instrument calibration.

WARNING

MAINTENANCE DESCRIBED HEREIN IS PERFORMED WITH POWER SUPPLIED TO THE INSTRUMENT, AND PROTECTIVE COVERS REMOVED. 100 VOLTS TO 240 VOLTS AC MAY BE PRESENT IN THE 5508A EVEN WHEN THE FRONT PANEL POWER SWITCH IS SET TO OFF. MAINTENANCE SHOULD BE PERFORMED ONLY BY SERVICE-TRAINED PERSONNEL WHO ARE AWARE OF THE HAZARDS INVOLVED (FOR EXAMPLE, FIRE AND ELECTRIC SHOCK). WHERE MAINTENANCE CAN BE PERFORMED WITHOUT POWER APPLIED, THE POWER CORD SHOULD BE REMOVED.

CAUTION

The 10757A/B/C circuitry is susceptible to damage from electrostatic discharge, therefore use an anti-static work station and ground straps when handling printed circuit assemblies during assembly or disassembly.

NOTE

The 10757A/B/C temperature sensor should only be immersed in dielectric liquid. Flourinert FC-40 or equivalent. The sensor should not be immersed in water.

4-51. The equipment in Table 4-1 should be configured to form the system depicted in Figure 4-1.

a. Remove the four screws on the 10757A/B/C enclosure.

b. Remove the 10757A/B/C cover noting how the printed circuit board is mounted.

c. Inspect cable and connectors for damage.

d. Secure 10757-60001 circuit board into one case half such that power can be applied and potentiometer A1R1 and A1R6 can be adjusted.

e. Immerse the sensor head into the bath in close proximity to the quartz thermometer probe without resting either on the inside of the bath housing.

f. Connect 10757A/B/C cable assembly to 5508A rear panel connector marked MATERIAL TEMPERATURE 1.

g. On the 5508A rear panel, set the ENGLISH/METRIC switch to METRIC.

h. Plug 5508A into AC outlet and set the LINE switch to ON.

i. Wait 10 minutes until 5508A goes through its warm-up countdown sequence and the display flashes LASr FAIL. If the 5508A fails its self-test or the warm-up countdown does not end with LASr FAIL, check setup and see 5528A Block Diagram and System Troubleshooting, in Section VIII.

j. Replace cal match jumper JB1 with a new jumper, HP Part Number 1810-0520. Punch one conductor to match the jumper to the following diagram.

P where P is a punched (broken) conductor and
U U is an unpunched conductor.
U
U
U
U
U
U

k. Set bath temperature to 0°C ±1°C. Place the thermometer and 10757A/B/C sensor cable end in close proximity in bath away from bath walls.

l. Allow bath to stabilize for an additional 20 minutes after the bath temperature has reached 0°C ±1°C.

m. Connect DVM + and - leads to TP1 and TP2, respectively. Note DVM reading (this reading will be referred to as V_o). Note thermometer reading (this reading will be referred to as T_o).

n. Set bath temperature to 40°C ±3°C. Allow bath to stabilize for an additional 20 minutes after the bath reaches 40°C ±3°C.

o. Read DVM (this reading will be called V_{40}). Note thermometer reading (this reading will be called T_{40}).

p. Next, calculate the adjustment voltage V_{A1}:

$$V_{A1} = V_{40} + \left[(145.2 - T_{40}) \times \left(\frac{V_{40} - V_o}{T_{40} - T_o} + 0.0335 \right) \right]$$

q. Adjust the gain trimport A1R6 until the DVM reads this voltage.

r. Again note the 2804A reading (new T_{40}). Calculate V_{A2}:

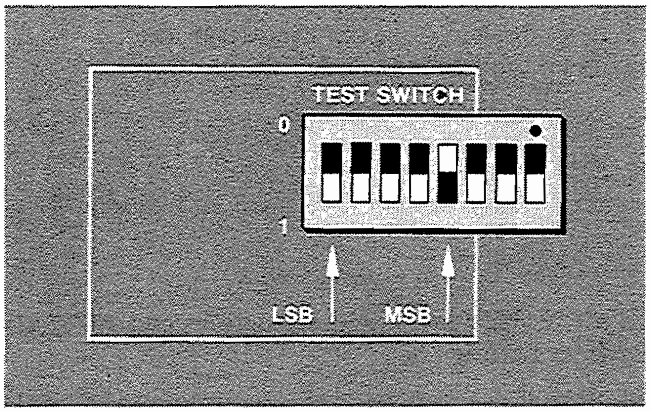
$$V_{A2} = -0.0335\ (T_{40} - 25.36)$$

s. Adjust the offset trimport A1R1, and if necessary the coarse offset adjustment jumper S1 until the DVM reads V_{A2}.

t. The accuracy of the calibration may be checked, if desired, by performing a calibration match to the 5508A using during testing (see Paragraph 4-45) and adjusting the bath temperature over the 0°C to 40°C operating range.

Procedure:

1. Perform the 5508A Calibration, Paragraphs 4-27 through 4-35.
2. Set 5508A Test Switch A2S3 to 0001 0000 and toggle the 5508A Master Reset switch A2S2.



The 5508A display should read 0.0000 mm, if not, check A2S3 setting and see 5528A Block Diagram and System Troubleshooting.

3. On 5508A, press MATL TEMP twice on 5508A front panel to display

1 XX.XX C

where XX.XX is the temperature measured by the 10757A/B/C.

4. Perform the calibration matching procedure (see Paragraph 4-45) to adjust the 10757A/B/C sensor for the 5508A Measurement Display in use.
5. The bath temperature can now be adjusted to various temperatures within the range of 0°C to 40°C in order to verify temperature measurement specifications of the 10757A/B/C. The reading of the thermometer should be allowed to stabilize at each selected temperature to within ±0.03°C for 10 minutes before comparing the reading to that on the 5508A Measurement Display.

   If any reading within the operating range indicates measurement error outside the accuracy specification of the 10757A/B/C, the Temperature Sensor Assembly (see Figure 6-11) should be replaced and the calibration procedure repeated.

6. Turn 5508A AC power off.
7. Remove 10757A/B/C temperature sensor from the bath and allow to dry.
8. Reassemble 10757A/B/C.

Table 4-3. Test Record

	Test or Calibration	Date/Entry	Date/Entry
1.	5518A Laser Power Output Test	______ /______	______ /______
2.	5518A Receiver Gain Test	______ /______	______ /______
3.	5508A ÷10V_{ref}	______ /______	______ /______
4.	CAL A (decimal)	______ /______	______ /______
5.	5508A ÷0.5V_{ref}	______ /______	______ /______
6.	CAL B (decimal)	______ /______	______ /______
7.	10751A/B Calibration	______ /______	______ /______
8.	10757A/B/C Calibration	______ /______	______ /______

4-52. HP-IB DIAGNOSTICS

4-53. The following paragraphs present diagnostic tests to verify proper operation of the 5508A HP-IB. Two methods are presented, the first gives several short programs that can be quickly entered into an HP 85 Controller to check if the HP 85 can control the 5508A using the HP-IB. The second method consists of an extensive check of the program codes and may be entered into the HP 85 then stored on a tape cartridge for future use.

4-54. The diagnostic checks require the following equipment:

a. HP 85 Computer with HP 82937A HP-IB Interface.

b. HP 82936A ROM Drawer.

c. HP 82903A 16K Memory Module.

d. HP 5508A Measurement Display.

e. HP 10751A/B Air Sensor.

f. HP 10757A/B/C Material Temperature Sensor.

4-55. Quick Diagnostic Checks

4-56. To run these checks, proceed as follows:

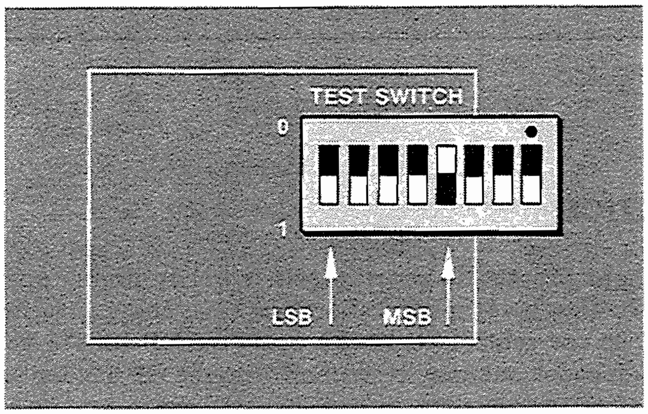
a. On the 5508A, set LINE switch to OFF.

b. Using the HP 82937A Interface Cable, connect the large connector to the HP 85. Connect the other connector (24 pin) of the HP 82937A to the 5508A Connector marked IEEE STD 488 PORT.

c. Connect the HP 10751A/B to the 5508A rear panel jack marked AIR SENSOR.

d. Connect HP 10757A/B/C to the 5508A rear panel jack marked MATERIAL TEMPERATURE 1.

e. Refer to Paragraph 3-62 and set the HP-IB address to 03. Also while the top cover is off, set the TEST SWITCH on A2 as shown below:



f. Apply power to the 5508A and toggle the MASTER RESET switch on A2.

g. Type the following program into the HP 85. The program may be stored on the tape cartridge by typing STORE "TESTA" then END LINE.

*********************************** **TESTA** ***********************************

```
10 REM :TESTA
```

```
20 OUTPUT 703 USING "K" ; "UET1
"
```

Send program codes "UE" and "T1" to 5508A. This configures the 5508A to English units and loads T1 data into the output buffer.

```
30 OUTPUT 703 USING "K" ; "RC"
```

Send program code "RC" to trigger 5508A to send the data back to the HP 85.

```
40 ENTER 703 ; A$
```

Enter the data into string variable A$.

(Continued)

```
50 PRINT "MATERIAL SENSOR TEMP
   IS:";A$;" DEGREES F"
```

On the HP 85 printer, print the information in quotes and the data in A$.

```
60 END
```

h. On the 5508A front panel, press RESET.

i. On the 5508A, press RUN. The 5508A display should read the temperature of Material Temperature Sensor 1 and a printout similar to that shown below should appear on the HP 85 printer.

```
MATERIAL SENSOR TEMP IS:
    77.633 DEGREES F
```

j. Repeat the procedure for the following tests, TESTB through TESTH.

************************************** **TESTB** **************************************

```
10 REM : TESTB
```

```
20 OUTPUT 703 USING "K" ; "AP"
```

5508A loads air pressure data into the output buffer.

```
30 OUTPUT 703 USING "K" ; "RC"
```

Trigger 5508A to send measurement back to HP 85.

```
40 ENTER 703 ; A$
```

Enter data into A$.

```
50 PRINT "AIR PRESSURE IS:
        ";A$;" INCHES HG"
```

Print air pressure measurement.

```
60 END
```

HP 85 PRINTOUT

```
AIR PRESSURE IS:
      29.83 INCHES HG
```

************************************ **TESTC** ************************************

```
10 REM :TESTC
```

```
20 OUTPUT 703 USING "K" ; "AH"
```

5508A loads air humidity data into the output buffer.

```
30 TRIGGER 703
```

Alternate method to command 5508A to send data to HP 85.

```
40 ENTER 703 ; A$
```

Enter data into A$.

```
50 PRINT "THE HUMIDITY SWITCH O
   N 10751A IS SET TO:";A$
```

Print the air humidity switch setting.

```
60 END
```

HP 85 PRINTOUT

```
THE HUMIDITY SWITCH ON 10751A IS
 SET TO:      50.
```

************************************ **TESTD** ************************************

```
10 REM :TESTD
```

```
20 DATA "UEAT","F","UMAT","C"
```

Establishes data to be read by lines 40 and 80. "UEAT" and "F" will be used to load english air temp into the output buffer. "UMAT" and "C" makes a metric measurement.

```
*30 FOR I=1 TO 2
```

```
*40 READ B$
```

Read from line 20 and assign to B$. When I = 1, B$ = "UEAT" from line 20, when I = 2, B$ = "UMAT".

(Continued)

```
* 50 OUTPUT 703 USING "K" ; B$
```

Command 5508A to assume the program code in B$. When I = 1, B$ = "UEAT", when I = 2, B$ = "UMAT".

```
* 60 TRIGGER 703
```

```
* 70 ENTER 703 ; A$
```

```
* 80 READ C$
```

Read from line 20 and assign to C$. When I = 1, C$ = F, when I = 2, C$ = C".

```
* 90 PRINT "10751A AIR TEMP IS:
           ";A$;" DEGREES ";C$
```

Print air temperature in degrees F when I = 1, in degrees C when I = 2.

```
*100 NEXT I
```

```
 110 END
```

*** For-next loop**

HP 85 PRINTOUT

```
10751A AIR TEMP IS:
       82.52 DEGREES F
10751A AIR TEMP IS:
       28.06 DEGREES C
```

************************************ TESTE ************************************

```
 10 REM :TESTE
```

```
 20 A=0
```

Set variable = 0

```
 30 OUTPUT 703 USING "K" ; "UE"
```

Command 5508A to English mode.

(Continued)

```
* 40 DATA "10P1UE","inches","10P1
     UM","mm"
```

Data to read by lines 60 and 100.

```
* 50 FOR I=1 TO 2
```

```
* 60 READ B$
```

```
* 70 OUTPUT 703 USING "K" ; B$
```

```
* 80 TRIGGER 703
```

```
* 90 ENTER 703 ; A$
```

```
*100 READ C$
```

```
*110 A=A+1
```

Increment A by 1.

```
*120 IF A>1 THEN GOTO 140
```

Prints preset distance in English units when A = 1. Prints in Metric units when A = 2.

```
*130 PRINT "DISTANCE IS PRESET TO
     :     ";A$;"   ";C$
```

```
*140 IF A>1 THEN PRINT "
            OR          ";A$;"   ";C$
```

(Continued)

```
*150 NEXT I
```

```
*160 END
```

*** For-next loop**

HP 85 PRINTOUT

```
DISTANCE IS PRESET TO:
  10.00000 inches
        OR
   254.0000 mm
```

************************************ **TESTF** ************************************

```
*10 REM :TESTF
```

```
*20 DATA "5P1","10P1","15P1","20
    P1","25P1"
```

Data to be used in line 40.

```
*30 FOR I=1 TO 5
```

```
*40 READ N$
```

```
*50 OUTPUT 703 USING "K" ; N$
```

```
*60 TRIGGER 703
```

```
*70 ENTER 703 , A$
```

(Continued)

```
* 80 PRINT A$
```

```
* 90 NEXT I
```

```
 100 END
```

***For-next loop will loop 5 times to read 5 items in line 20.**

HP 85 PRINTOUT

```
 5.0000
10.0000
15.0000
20.0000
25.0000
```

*************************************** TESTG **

```
10 REM :TESTG
```

```
20 DATA “1R11.1P1","2R12.22P1",
   "3R13.333P1",“4R14.4444P1","
   5R15.55555P1",“6R16.666666P1
   "
```

Data to be used by line 4.

```
30 FOR I=1 TO 6
```

```
40 READ N$
```

```
50 OUTPUT 703 USING "K" ; N$
```

(Continued)

```
60 TRIGGER 703
```

```
70 ENTER 703 ; A$
```

```
80 PRINT A$
```

```
90 WAIT 1000
```

Pause approximately 1 second so operator can read 5508A display.

```
100 NEXT I
```

```
110 END
```

HP 85 PRINTOUT

```
      1.1
     2.22
    3.333
   4.4444
  5.55555
  0 ERROR
```

Occurs if 5508A is in metric and an attempt is made to preset the measurement to six places beyond the decimal point.

*********************************** TESTH ***********************************

```
10 REM :TESTH
```

Same test as "TESTG" except line 20 sets 5508A to English units so no error occurs for last data item ("6's").

```
20 OUTPUT 703 USING "K" ; "UE"

30 DATA "1R11.1P1","2R12.22P1",
   "3R13.333P1","4R14.4444P1","
   5R15.55555P1","6R16.666666P1
   "

40 FOR I=1 TO 6

50 READ N$

60 OUTPUT 703 USING "K" ; N$

70 TRIGGER 703

80 ENTER 703 ; A$

90 PRINT A$

100 WAIT 1000
```

(Continued)

```
110 NEXT I
```

```
120 END
```

HP 85 PRINTOUT

```
      1.1
     2.22
    3.333
   4.4444
  5.55555
 6.666666
```

Corrected by line 20.

4-57. Instrument Function Codes Diagnostic

4-58. This test performs the following:

a. Sends instrument function codes from the HP 85 to the 5508A. This configures the 5508A into a particular mode with a corresponding measurement. For example, when code T3 is sent, the 5508A is configured to measure the temperature of Material Temperature Sensor No. 3. Note that when a sensor is disconnected, the "measurement" is "999999999".

b. Triggers the 5508A to send the measurement data to the HP 85.

c. Compares the received data to expected data. The expected data is written into the program. If the received data is the same as the expected data, the test continues to the next code to be tested. If all tests pass, a message to that effect is printed on the HP 85. If the data does not compare properly, a fail test message is printed along with the received data and the expected data, then the program halts.

4-59. To run this test, connect the equipment as described in paragraph 4-56 except DO NOT connect the Air or Material Sensors. The sensors are not used so that known data (999999999.) will be returned to the controller. Set the HP-IB address switch and the A2 TEST switch as described in paragraph 4-56e.

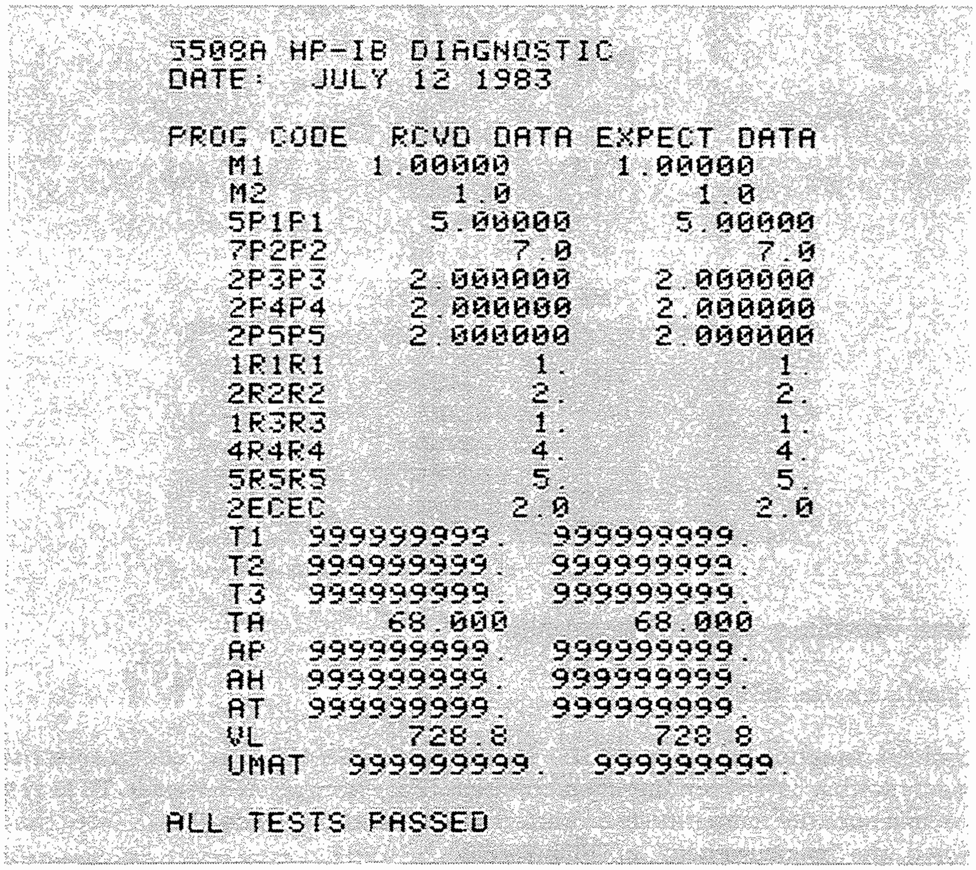
a. Type the following program into the HP 85. After entry, the program may be stored on a tape cartridge for future use by typing STORE "HPTEST".

b. On the 5508A front panel, press RESET.

c. On the HP 85, press RUN and follow the instructions on the HP 85 display. If all tests pass, the printout will be the same as shown below.

d. The results of a failed test may be observed by connecting an Air Sensor or a Material Temperature Sensor to the 5508A. With a sensor connected, the 5508A will return a measured sensor value instead of the expected "999999999." (the data returned for a disconnected probe).

PRINTOUT FOR A SUCCESSFUL DIAGNOSTIC



```
5508A HP-IB DIAGNOSTIC
DATE:   JULY 12 1983

PROG CODE  RCVD DATA EXPECT DATA
   M1      1.00000      1.00000
   M2          1.0          1.0
   5P1P1     5.00000      5.00000
   7P2P2         7.0          7.0
   2P3P3    2.000000     2.000000
   2P4P4    2.000000     2.000000
   2P5P5    2.000000     2.000000
   1R1R1          1.           1.
   2R2R2          2.           2.
   1R3R3          1.           1.
   4R4R4          4.           4.
   5R5R5          5.           5.
   2ECEC         2.0          2.0
   T1  999999999.  999999999.
   T2  999999999.  999999999.
   T3  999999999.  999999999.
   TA      68.000      68.000
   AP  999999999.  999999999.
   AH  999999999.  999999999.
   AT  999999999.  999999999.
   VL     728.8       728.8
   UMAT  999999999.  999999999.

ALL TESTS PASSED
```

************************************ **HPTEST** ************************************

```
10 REM :HPTEST
```

```
20 DISP "ENTER DATE (MONTH DAY
   YEAR) USE NO COMMAS PRESS EN
   D LINE" @ INPUT D$
```

@ sign allows multi-statement lines. Input D$ stops the program requiring a keyboard input in this instance, the date.

```
30 PRINT "5508A HP-IB DIAGNOSTI
   C" @ PRINT "DATE:  ";D$
```

Prints date entered in 20.

```
40 DISP "PRINT DATA? Y=YES N=NO
    PRESS END LINE" @ PRINT ""
```

Allows user to select data printed or no data.

```
50 INPUT W$
```

W$ will be equal to Y or N for future use.

(Continued)

```
 60 OUTPUT 703 USING "K" ; "UE";
    "RS";"1P1";"1P2";"1P3";"1P4"
    ;"1P5";"5R1";"1R2";"0R3";"4R
    4"
```

Initial program codes to configure 5508A to proper values before running test.

```
 70 OUTPUT 703 USING "K" ; "5R5"
    ;"0EC";"728 8VL";"68TA"
```

Data values to be used during test. See typing aid following this program listing to help typing in the blank spaces before the numbers.

```
 80 DATA "M1","     1.00000","M2
    ","         1.0","5P1P1","
       5.00000","7P2P2","
      7.0"
```

```
 90 DATA "2P3P3","    2.000000",
    "2P4P4","    2.000000","2P5P
    5","    2.000000","1R1R1"
```

```
100 DATA "          1.","2R2R2",
    "          2.","1R3R3","
          1.","4R4R4","
     4."
```

```
110 DATA "5R5R5","          5.",
    "2ECEC","         2.0","T1",
    "  999999999.","T2","  99999
    9999."
```

```
120 DATA "T3","  999999999.","TA
    ","      68.000","AP","  999
    999999.","AH","  999999999."
```

```
130 DATA "AT","  999999999.","VL
    ","       728.8","UMAT","  9
    99999999."
```

(Continued)

```
*140 FOR I=1 TO 22 @ READ N$
```

Reads data from lines 80 through 130. When I = 1, reads "M1".

```
*150 OUTPUT 703 USING "K" ; N$
```

Sends N$ (Program code) to 5508A.

```
*160 OUTPUT 703 USING "K" ; "RC"
```

Triggers 5508A to send measurement back to HP 85.

```
*170 ENTER 703 , A$
```

Place measurement in A$.

```
*180 GOSUB 220
```

GOSUB for comparison test of received data and expected data.

```
*190 NEXT I
```

```
 200 PRINT "" @ PRINT "ALL TESTS
     PASSED" @ PRINT "" @ PRINT "
     " @ PRINT "" @ PRINT ""
```

If all tests pass, after 22 loops, program executes this line, then goes to line 210.

```
 210 END
```

Ends Program.

```
 220 READ Z$
```

Reads expected data from line 80 through 130. When I = 1, reads bbbbb1.00000, where b = blank spaces.

```
 230 IF A$=Z$ THEN GOTO 270 ELSE
     PRINT N$;" FAILED"
```

Test comparison, if expected data equals received data, program goes to 270, otherwise prints test failed message.

```
 240 BEEP 70,300 @ BEEP 70,300 @
     BEEP 70,300 @ BEEP 115,500
```

Sound effects to signal that test failed.

(Continued)

---

* **For-next loop**

```
250 PRINT "DATA SHOULD BE:" @ PR
    INT Z$
```

Prints the data for the failed test.

```
260 PRINT "DATA WAS:" @ PRINT A$
     @ END
```

```
270 IF W$="Y" AND N$="M1" THEN P
    RINT "PROG CODE";"  RCVD DAT
    A";" EXPECT DATA"
```

Used when operator specifies to print data (W$ = "Y").

```
280 IF W$="Y" THEN PRINT "    ";N
    $;A$;Z$
```

```
290 RETURN
```

Returns to 190.

Line	Instrument Function Code	TYPING AID Numeric Value and Blanks		
80	M1			
80	M1	bbbbb1.00000	(5b's)	(5-0's)
80	M2	bbbbbbbbb1.0	(9b's)	(1-0)
80	5P1P1	bbbbb5.00000	(5b's)	(5-0's)
80	7P2P2	bbbbbbbbb7.0	(9b's)	(1-0)
90	2P3P3	bbbb2.000000	(4b's)	(6-0's)
90	2P4P4	bbbb2.000000	(4b's)	(6-0's)
90	2P5P5	bbbb2.000000	(4b's)	(6-0's)
90, 100	1R1R1	bbbbbbbbbb1.	(10b's)	(no 0's)
100	2R2R2	bbbbbbbbbb2.	(10b's)	(no 0's)
100	1R3R3	bbbbbbbbbb1.	(10b's)	(no 0's)
100	4R4R4	bbbbbbbbbb4.	(10b's)	(no 0's)
110	5R5R5	bbbbbbbbbb5.	(10b's)	(no 0's)
110	2ECEC	bbbbbbbbb2.0	(9b's)	(1-0)
110	T1	bb999999999.	(2b's)	(9-9's)
110	T2	bb999999999.	(2b's)	(9-9's)
120	T3	bb999999999.	(2b's)	(9-9's)
120	TA	bbbbbb68.000	(6b's)	(3-0's)
120	AP	bb999999999.	(2b's)	(9-9's)
120	AH	bb999999999.	(2b's)	(9-9's)
130	AT	bb999999999.	(2b's)	(9-9's)
130	VL	bbbbbbb728.8	(7b's)	
130	UMAT	bb999999999	(2b's)	(9-9's)

b is equivalent
to pressing space
bar when entering program

SECTION V
ADJUSTMENTS

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SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section describes adjustments and checks required to return the 5528A instruments to peak operating capabilities when repairs have been made. Included in this section are test equipment required, equipment setups and procedures to perform the adjustments.

5-3. SAFETY CONSIDERATIONS

5-4. The following warnings contain information that must be understood for your safety.

WARNING

FROM 1.8 KILOVOLTS TO 12 KILOVOLTS DC IS PRESENT ON THE ANODE OF THE LASER TUBE IN THE 5518A. EXERCISE EXTREME CAUTION WHEN WORING INSIDE THE INSTRUMENT. THE HIGH VOLTAGE COULD CAUSE SERIOUS PERSONAL INJURY IF CONTACTED. THE FOLLOWING ADJUSTMENTS SHOULD BE PERFORMED BY SERVICE-TRAINED PERSONNEL.

5-5. RECOMMENDED TEST EQUIPMENT

5-6. Test equipment required for each adjustment is included in the adjustment procedure. Detailed critical specifications for the required test equipment are contained in Table 1-4. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

5-7. FACTORY SELECTED COMPONENTS

5-8. As of the publication date on the title page of this manual there re no factory selected components.

5-9. ADJUSTMENT PROCEDURES

5-10. The following paragraphs contain the adjustment procedures for the Laser Measurement System. Performance test and calibration procedures are located in Section IV.

5-11. 5518A Receiver Adjustments

5-12. This adjustment sets the 5518A receiver gain so that the SIGNAL indicator illuminates when the returned laser beam power in 8.5% of the laser output power. This also corresponds to 10% of the signal returned from a typical 10767A Retroreflector.

5-13. Test Equipment Required. The receiver gain adjustment requires the following test equipment:

Neutral Density Filter 31.6% Transmission, Oriel* Model 5034

Laser Power Meter, United Detector Technology Model 351L

Retroreflector, HP Model 10767A

Additional Equipment for Convenience

Height Adjuster and Post, HP Model 10785A

Base, HP Model 10784A

5-14. Preliminary Procedure. Observe the safety precautions in Paragraph 5-3 and proceed as follows:

a. On the Laser Head, remove the 4 pozi-drive screws at each corner of the top cover.

b. Remove the Laser Head top cover by pulling up on each end.

c. On the 5518A, set the turret to OTHER and both turret shutters to the largest aperture.

d. On the 5508A, set the LINE switch to ON. Wait until the system completes the warm-up cycle (approximately 3 to 10 minutes). PA Error will be displayed when the warm-up cycle is complete. If the 5508A fails self test or the warm-up countdown does not end with PA Error, see 5528A Block Diagram and System Troubleshooting in Section VIII.

5-15. Procedure

a. Using the Laser Power Meter, align the power meter detector for maximum reading.

b. If the laser power output is less than 100 microwatts, see Laser High Voltage Troubleshooting in Section VIII.

c. Place the Retroreflector assembly about 6 inches from the Laser Head and align the Retroreflector to return the laser beam to the return aperture. Place a piece of white card stock in the return beam path. If there is a dark line in the beam, rotate the 10767A 90°. Remove the card stock

1000-0598 7119 - P/N

d. Place the 31.6% filter flush with the turret so that both the emitted beam and the return beam will pass through the filter. Align for maximum indication on the 5508A BEAM STRENGTH meter.

e. On A2, adjust R3 GAIN potentiometer (Figure 5-1) clockwise until the SIGNAL indicator goes off when the beam is blocked and on when the beam is unblocked. If the indicator does not come on, readjust A2R3 slightly more counter-clockwise and repeat.

g. Replace the Laser Head top cover.

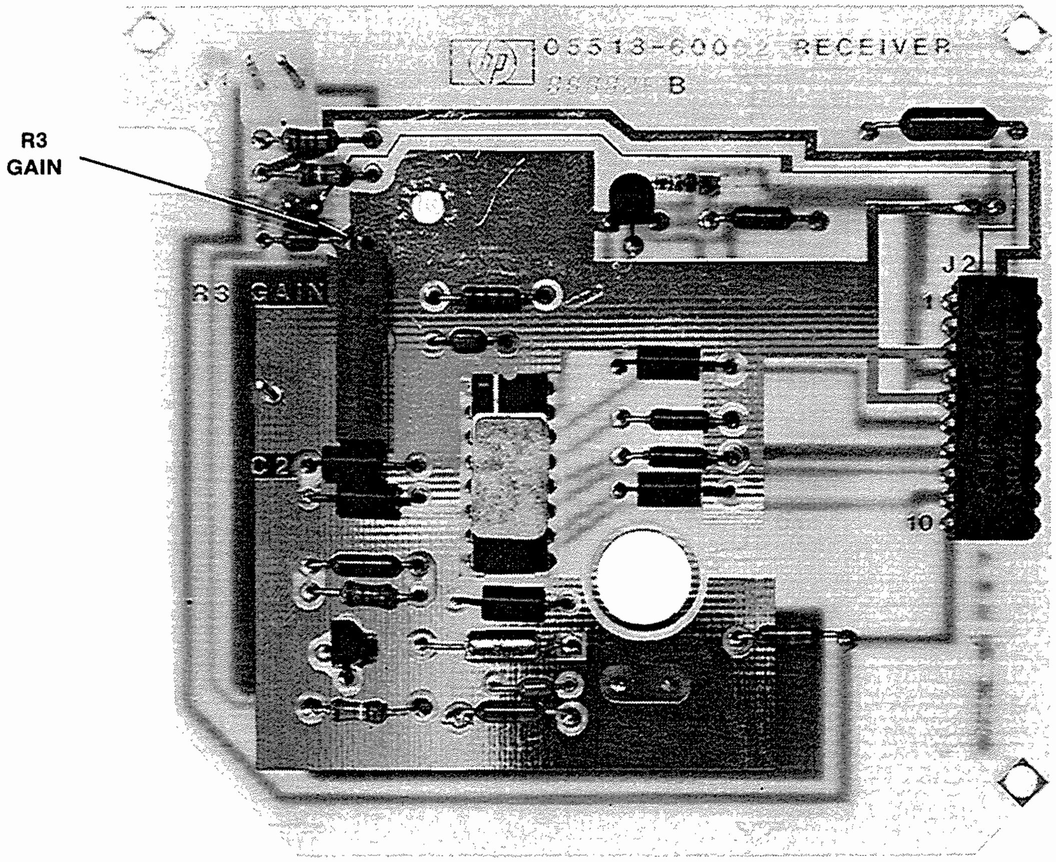

Figure 5-1. 5518A A2 Receiver Board, Adjustment Location

5-16. 5518A Reference Temperature Adjustments

5-17. This adjustment sets the laser preheat temperature to 105°C (221°F). The adjustment must be performed at room temperature, 21 to 25°C (69.8 to 77.0°F).

5-18. Test Equipment Required. The reference temperature adjustment requires the following test equipment:

Digital Voltmeter, HP 3456A

5-19. Preliminary Procedure

5-20. The adjustment may be made from either a cold start or when power has been applied for some period of time. In either case with power on or off, observe the safety precautions in paragraph 5-3 and proceed as follows:

a. On the Laser Head, remove the 4 pozi-drive screws at each corner of the top cover.

b. Remove the Laser Head top cover by pulling up on each end.

c. On A3, change the small blue HEATER jumper from NORM to OFF. See Figure 5-2.

d. Apply power to the Digital Voltmeter and set its controls to the 1 volt DC range. Connect the positive lead of the Digital Voltmeter to A3TP11, connect the negative lead to A3TP1. See Figure 5-2.

e. If primary power has been off for less than 2 hours, set the 5508A LINE switch to ON and wait until the Digital Voltmeter reading stabilizes to within 1 millivolt in 10 minutes, then proceed with the adjustment procedure. Stabilization may take up to 2 hours.

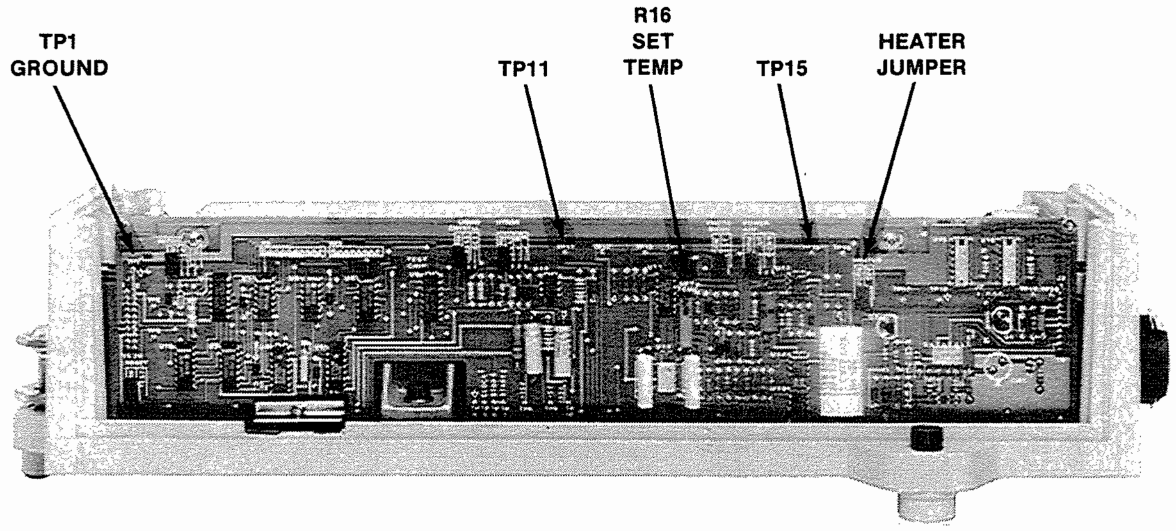

Figure 5-2. 5518A A3 Controller/ Ref Board, Jumpers, Test Points, and Adjustment Locations

5-21. Procedure. To adjust the reference temperature, proceed as follows:

a. Check that the Voltmeter reads between 0.2V and 0.3V. This voltage is V(A3TP11) and must be stable to within ±1 millivolt within a 10 minute period. see step f in the preliminary procedure above.

b. Calculate the heater adjust set point using the following equation $V_{set} = 1.285 \times V(A3TP11)$.

c. Connect Digital Voltmeter positive lead to A3TP15. Connect the negative lead to ground. See Figure 5-3.

d. Check that the voltage at A3TP15 equals V_{set} ±1 millivolt as calculated in step b. If not, adjust A3R16 SET TEMP (See Figure 5-2). Note that the value for V_{set} will be different for each laser tube.

e. Note and record the SET TEMP voltage in Table 5-1.

f. On A3, change the small blue HEATER jumper back to NORM. Remove the test equipment leads, and reinstall the laser Head cover.

5-22. 5518A Laser Tube Current Adjustment

5-23. This procedure adjusts the laser tube current to 3.5 milliamperes ±0.1 milliampere.

5-24. Test Equipment Required. The laser current adjustment requires the following test equipment.

Millammeter, HP Model 428B

5-25. Procedure. To adjust the laser tube current, observe the safety precautions in Paragraph 5-3 and proceed as follows:

a. Set the 5508A LINE switch to OFF.

b. On the Laser Head, remove the 4 pozi-drive screws at each corner of the top cover.

c. Remove the Laser Head top cover by pulling up on each end.

d. Set the milliammeter to the 10 milliampere range.

e. Locate the anode lead that connects between the high voltage power supply and the ballast resistor. See Figure 5-3. Clip the milliammeter probe to this lead with the arrow on the probe pointing away from the power supply. Keep the probe as far as possible from and perpendicular to the magnet assemblies. It may be necessary to prop up the probe to achieve the perpendicular orientation.

f. On the milliammeter, adjust for zero indication. If zero indication cannot be obtained, degauss the probe as directed on the back of the milliammeter.

NOTE

After the zero setting has been made on the milliammeter, do not move the probe, this will negate the zero setting.

g. On the 5508A, set the LINE switch to ON.

h. Adjust A1R3 (Figure 5-1) for 3.5 milliamperes ±0.1 milliampere.

i. Record the Laser Tube current in Table 5-1.

j. Set the 5508A LINE switch to OFF, disconnect the probe, and reinstall the Laser Head cover.

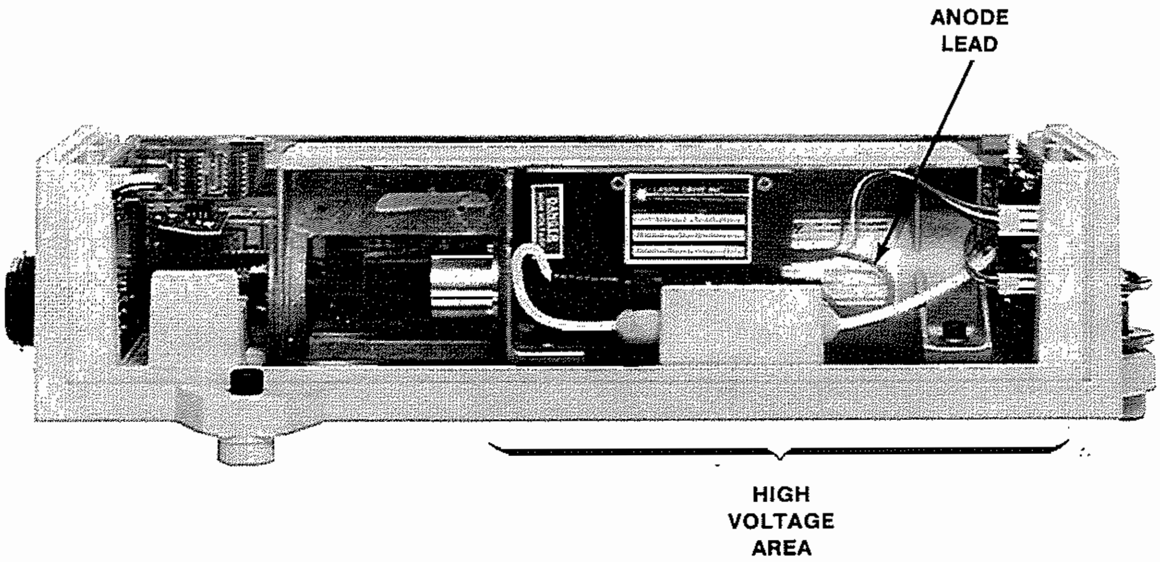

Figure 5-3. 5518A High Voltage Area and Anode Lead

Table 5-1. Adjustment Record

Adjust	Date / Value	Date / Value	Date / Value	Date / Value
Laser Output Power	_____ / _____ uW	_____ / _____ uW	_____ / _____ uW	_____ / _____ uW
V_{set}	_____ / _____ V	_____ / _____ V	_____ / _____ V	_____ / _____ V
Laser Tube Current	_____ / _____ ma	_____ / _____ ma	_____ / _____ ma	_____ / _____ ma

SECTION VI
REPLACEABLE PARTS

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SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This chapter contains information for ordering parts. The following replaceable parts lists are included.

Table 6-1	Replaceable Parts, Tables, and Figures
Table 6-2	Reference Designations and Abbreviations
Tables 6-3 through 6-6	Replaceable Parts
Table 6-7	Manufacturer's Codes

6-3. REFERENCE DESIGNATIONS

6-4. *Table 6-2* lists the abbreviations and reference designations used in the parts lists, block diagrams, and throughout the manual.

6-5. REPLACEABLE PARTS

6-6. Tables 6-3 through 6-6 are the lists of replaceable parts and are organized as follows:

1. Electrical assemblies in alphanumerical order by reference designation.
2. Chassis-mounted electrical parts in alphanumerical order by reference designation.
3. Chassis-mounted mechanical parts in alphanumerical order by reference designation.

6-7. The information given for each part consists of the following:

1. Reference Designation
2. Hewlett-Packard part number.
3. Part number check digit (CD).
4. Total quantity (QTY) in instrument. The total quantity is given once and at the first appearance of the part number in the list.
5. Description of the part.
6. Typical manufacturer's part number for the part.

6-8. EXCHANGE ASSEMBLIES

6-9. The Laser Tube assembly may be replaced on an exchange basis. Factory repaired and tested exchange assemblies are available only on a trade-in basis; therefore, the defective assemblies must be returned for credit. For this reason, assemblies required for spare parts stock must be ordered by the "new assembly" part number. The part numbers for the Laser Tube Assembly are listed below:

ASSEMBLY	NEW ASSEMBLY HP PART NUMBER	EXCHANGE ASSEMBLY HP PART NUMBER
Laser Tube Assembly	05517-60801	05517-60501

6-10. HOW TO ORDER A PART

6-11. Hewlett-Packard wants to keep your parts ordering process as simple and efficient as possible. Think of the process as having the following steps:

- Identifying the part and the quantity that you want.
- Determining the ordering method to be used and contacting Hewlett-Packard.

6-12. Parts Identification

6-13. To identify the part(s) you want, first refer to the replaceable parts lists (*Tables 6-3 and 6-6)* in this chapter.

6-14. When ordering from Hewlett-Packard, the important numbers to note from the Parts List are the HP Part Number and part-number check digit (in the "CD" column), and the quantity of the part you want.

6-15. If the part you want is NOT identified in the manual, you can call on Hewlett-Packard for help (see the following section ("Contacting Hewlett-Packard"). Please have the following information at hand when you contact HP for help:

- Instrument Model Number (example "HP 5508A").
- Complete instrument Serial Number (example "1234A56789"). Information about where to find the serial number is given in the preface of this manual in the "HOW TO USE THIS MANUAL" section.
- Description of the part and its use.
- Quantity of the part required.

6-16. Contacting Hewlett-Packard

6-17. Depending on where you are in the world, there are one or more ways in which you can get parts or parts information from Hewlett-Packard.

- Outside the United States, contact your local HP sales office. HP sales offices are listed at the back of this manual.
- Within the United States, we encourage you to order replacement parts or request parts information directly by telephone or mail from the HP Support Materials Organization, using the telephone numbers or address listed below. (You can also contact your local HP sales office. HP sales offices are listed at the back of this manual.)

6-18. By telephone:

a. For Parts Ordering, use our toll-free number (800) 227-8164, Monday through Friday (except Holidays), 6 am to 5 pm (Pacific Time).

b. If you need a part in a hurry, an extra-cost Hotline phone ordering service is available, 24 hours a day. Use the toll free number above at the times indicated; at other times, use (916) 785-8460.

c. For Parts Identification Assistance, call us at (916) 783-0804. Our Parts Identification hours are from Monday through Friday, 6 am to 5 pm (Pacific Time).

6-19. For mail correspondence, use the address below:

Hewlett-Packard
Support Materials Roseville
P.O. Box 1145
Roseville, Ca 95661-1145

6-20. CABINET PARTS AND HARDWARE:

6-21. To locate and identify miscellaneous cabinet parts, refer to *Figures 6-1 through 6-12.* These figures provide exploded views of the cabinet, with the parts identified by reference designations; the reference designations correspond with the ones in *Tables 6-3 through 6-6.*

Table 6-2. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

A = assembly
AT = attenuator, isolator termination
B = fan; motor
BT = battery
C = capacitor
CP = coupler
CR = diode, diode thyristor varactor
DC = directional coupler
DL = delay line
DS = annunciator, signaling device (audible or visual); lamp; LED
E = miscellaneous electrical part
F = fuse
FL = filter
H = hardware
HY = circulator
J = electrical connector; (stationary portion); jack
K = relay
L = coil, inductor
M = metre
MP = miscellaneous mechanical part
P = electrical connector (movable portion); plug
Q = transistor; SCR; triode thyristor
R = resistor
RT = thermistor
S = switch
T = transformer
TB = terminal board
TC = thermocouple
TP = test point
U = integrated circuit; microcircuit
V = electron tube
VR = voltage regulator; breakdown diode
W = cable; transmission path; wire
X = socket
Y = crystal unit-piezo-electric
Z = turned cavity; tuned circuit

ABBREVIATIONS

A = ampere
ac = alternating current
ACCESS = accessory
A/D = analog-to-digital
AF = audio frequency
AFC = automatic frequency control
AGC = automatic gain control
AL = aluminum
ALC = automatic level control
AM = amplitude modulation
AMPL = amplifier
APC = automatic phase control
ASSY = assembly
AUX = auxiliary
AVG = average
AWG = American wire gage
BAL = balance
BCD = binary coded decimal
BD = board
BE CU = beryllium copper
BFO = beat frequency oscillator
BH = binder head
BKDN = breakdown
BP = bandpass
BPF = bandpass filter
BRS = brass
BWO = backward-wave oscillator
CAL = calibrate
ccw = counterclockwise
CER = ceramic
CHAN = channel
cm = centimeter
CMO = coaxial
COEF = coefficient
COM = common
COMP = composition
COMPL l= complete
CONN = connector
CP = cadmium plate
CRT = cathode-ray tube
CTL = complementary transistor logic
CW = continuous wave
cw = clockwise
D/A = digital-to-analog
dB = decibel
dBm = decibel referred to 1mW
dc = direct current
deg = degree (temperature interval (or difference)
. . . ° = degree (plane angle)
°C = degree Celsius (centigrade)
°F = degree Fahrenheit
6K = degree Kelvin
DEPC = deposited carbon
DET = detector
diam = diameter
DIA = diameter (used in parts list)
DIFF AMPL = differential amplifier
div = division
DPDT = double-pole, double-throw
DR = drive
DSB = double sideband
DTL = diode transistor logic
DVM = digital voltmeter
ECL = emitter coupled logic
EMF = electromotive force
EDP = electronic data processing
ELECT = electrolytic
ENCAP = encapsulated
EXT = external
F = farad
FET = field-effect transistor
F/F = flip-flop
FH = flat head
FOL H = fillister head
FM = frequency modulation
FP = front panel
FREQ = frequency
FXD = fixed
g = gram
GE = germanium
GHz = gigahertz
GL = glass
GND = ground(ed)
H = henry
h = hour
HET = heterodyne
HEX = hexagonal

HD = head
HDW = hardware
HF = high frequency
HI = high
HP = Hewlett-Packard
HPF = high pass filter
HR = hour (used in parts list)
HV = high voltage
Hz = hertz
IC = integrated circuit
ID = inside diameter
IF = intermediate frequency
IMPG = impregnated
in = inch
INCD = incandescent
INCL = include(s)
INP = input
INS = insulation
INT = internal
kg = kilogram
kHz = kilohertz
kΩ = kilohm
kV = kilovolt
lb = pound
LC = inductance-capacitance
LED = light-emitting diode
LF = low frequency
LG = long
LH = left hand
LIM = limit
LIN = linear taper (used in parts list)
lin = linear
LK WASH = lockwasher
LO = low; local oscillator
LOG = logarithmic taper (used in parts list)
log = logarithm(ic)
LPF = low pass filter
LV = low voltage
m = metre (distance)
mA = milliampere
MAX = maximum
MΩ = megohm
MEG = meg (10^6) (used in parts list)
MET FLM = metal film
MET OX = metal oxide
MF = medium frequency; microfarad (used in parts list)
MFR = manufacturer
mg = milligram
MHz = megahertz
mH = millihenry
mho = conductance
MIN = minimum
min = minute (time)
. . . ′ = minute (plane angle)
MINAT = miniature
mm = millimetre
MOD = modulator
MOM = momentary
MOS = metal-oxide semiconductor
ms = millisecond
MTG = mounting
MTR = meter (indicating device)
mV = millivolt
mVac = millivolt, ac
mVdc = millivolt, dc
mVpk = millivolt, peak
mVp-p = millivolt, peak-to-peak
mVrms = millivolt, rms
mW = milliwatt
MUX = multiplex
MY = mylar
µA = microampere
µF = microfarad
µH = microhenry
µmho = micromho
µs = microsecond
µV = microvolt
µVac = microvolt, ac
µVdc = microvolt, dc
µVpk = microvolt, peak
µVp-p = microvolt, peak-to-peak
µVrms = microvolt, rms
µW = microwatt
nA = nanoampere
NC = no connection
N/C = normally closed

NE = neon
NEG = negative
nF = nanofarad
N/O = normally open
NOM = nominal
NORM = normal
NPN = negative-positive-negative
NPO = negative-positive zero (zero temperature coefficient)
NRFR = not recommended for field replacement
ns = nanosecond
NSR = not separately replaceable
nW = nanowatt
OBD = order by description
OD = outside diameter
OH = oval head
OP AMPL = operational amplifier
OPT = option
OSC = oscillator
OX = oxide
oz = ounce
Ω = ohm
P = peak (used in parts list)
PAM = pulse-amplitude modulation
PC = printed circuit
PCM = pulse code modulation pulse-count modulation
PDM = pulse-duration modulation
pF = picofarad
PH BRZ = phosphor bronze
PHL = Phillips
PIN =-positive-intrinsic-negative
PIV = peak inverse voltage
pk = peak
PL = phase lock
PLO = phase lock oscillator
PM = phase modulation
PNP = positive-negative-positive
P/O = part of
POLY = polystyrene
PORC = porcelain
POS = positive; position(s) used in parts list
POSN = position
POT = potentiometer
p-p = peak-to-peak
PP = peak-to-peak (used in parts list)
PPM = pulse-position modulation
RREAMPL = preamplifier
PRF = pulse-repetition frequency
PRR - pulse repetition rate
ps = picosecond
PT = point
PTM = pulse-time modulation
PWM = pulse-width modulation
PWV = peak working voltage
RC = resistance capacitance
RECT = rectifier
REF = reference
REG = regulated
REPL = replaceable
RF = radio frequency
RFI = radio frequency interference
RH = round head; right hand
RLC = resistance-inductance-capacitance
RMO = rack mount only
rms = root-mean-square
RND = round
ROM = read-only memory
R&P = rack and panel
RWV = reverse working voltage
S = scattering parameter
s = second (time)
. . .″ = second (plane angle)
S-B = slow-blow fuse (used in parts list)
SCR = silicon controlled rectifier; screw
SE = selenium
SECT = sections
SEMICON = semiconductor
SHF = superhigh frequency
SI = silicon
SIL = silver
SL = slide
SNR = signal-to-noise ratio
SPDT = single-pole, double-throw
SPG = spring
SR = split ring

SPST = single-pole, single-throw
SSB = single sideband
SST = stainless steel
SQ = square
SWR = standing-wave ratio
SYNC = synchronize
T = timed (slow-blow fuse)
TA = tantalum
TC = temperature compensating
TD = time delay
TERM = terminal
TFT = thin-film transistor
TGL = toggle
THD = thread
THRU = through
TI = titanium
TOL = tolerance
TRIM = trimmer
TSTR = transistor
TTL = transistor-transistor logic
TV = television
TVI = television interference
TWT = traveling wave tube
U = micro (10^{-6} used in parts list)
UF = microfarad (used in parts list)
UHF = ultrahigh frequency
UNREG = unregulated
V = volt
VA = voltampere
Vac = volts ac
VAR = variable
VCO = voltage-controlled oscillator
Vdc = volts dc
VDCW = volts, dc, working (used in prts list)
V(F) = volts, filtered
VFO = variable-frequency oscillator
VHF = very-high frequency
Vpk = volts peak
Vp-p = volts peak-to-peak
Vrms = volts rms
VSWR = voltage standing wave ratio
VTO = voltage-tuned oscillator
VTVM = vacuum-tube voltmeter
V(X) = volts, switched
W = watt
W/ = with
W/V = working inverse voltage
W/W = wirewound
W/O = without
YIG = yttrium-iron-garnet
Zo = characteristic impedance

NOTE
All abbreviations in the parts list will be in upper case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^9
M	mega	10^8
k	kilo	10^3
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
µ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

Search results:

Parts found matching your search criteria :47

Highlighted part numbers have images. Click the Images! icon to view part image.

Notes with asterisks (* Notes) are populated with note information

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			HP Part Number	PRIME 1 Descript.	PRIME 2 Descript.	EDC Descript. (SMO Internal Use)
Part to Product	SAM	Notes	05508-00001	PANEL, FRONT		PANEL, FRONT
Part to Product	SAM	Notes	05508-00002	PANEL, SUB		PANEL, SUB
Part to Product	SAM	Notes	05508-00003	CHASSIS		CHASSIS
Part to Product	SAM	Notes	05508-00004	PANEL, REAR		PANEL, REAR
Part to Product	SAM	Notes	05508-00005	COVER, REAR		COVER, REAR
Part to Product	SAM	Notes	05508-00006	BRACKET, LEFT		BRACKET, LEFT
Part to Product	SAM	Notes	05508-00007	BRACKET, RIGHT		BRACKET, RIGHT
Part to Product	SAM	Notes	05508-00008	COVER-LASER HEAD	BELOW SERIES 2536A	COVER-LASER HEAD
Part to Product	SAM	Notes	05508-00009	BRACKET, PC BD SUPPORT		BRACKET, PC BD SUPPORT
Part to Product	SAM	Notes	05508-00011	COVER-LASER HEAD	SERIES 2536A & UP	COVER-LASER HEAD
Part to Product	SAM	Notes	05508-00013	FRAME, FILTER		FRAME, FILTER
Part to Product	SAM	Notes	05508-00015	FOAM RUBBER PAD		FOAM RUBBER PAD
Part to Product	SAM	Notes	05508-20301	HEATSINK		HEATSINK
Part to Product	SAM	Notes	05508-20302	DISPLAY, WINDOW		DISPLAY, WINDOW
Part to Product	SAM	Notes	05508-20303	BAR, PC BD SPRI		BAR, PC BD SPRI
Part to Product	SAM	Notes	05508-20305	FASTENER		FASTENER
Part to Product	SAM	Notes	05508-20307	FASTENER, PC BD UPPER		FASTENER, PC BD UPPER
Part to Product	SAM	Notes	05508-40001	COVER, REMOTE CONTROL		COVER, REMOTE CONTROL
Part to Product	SAM	Notes	05508-40002	BASE, REMOTE CONTROL		BASE, REMOTE CONTROL
Part to Product	SAM	Notes	05508-60001	KYBD DSPL BD ASSY		KYBD DSPL BD ASSY

Part to Product	SAM	Notes	05508-60002	PROCESSOR BD ASSY		PROCESSOR BD ASSY
Part to Product	SAM	Notes	05508-60003	COUNTER A/D BD ASSY		COUNTER A/D BD ASSY
Part to Product	SAM	Notes	05508-60004	CONNECTOR BD AY		CONNECTOR BD AY
Part to Product	SAM	Notes	05508-60005	POWER SUPPLY BD AY		POWER SUPPLY BD AY
Part to Product	SAM	Notes	05508-60020	REMOTE CONTROL BD ASSY		REMOTE CONTROL BD ASSY
Part to Product	SAM	Notes	05508-60021	RMT CNTRL BOARD ASSY		RMT CNTRL BOARD ASSY
Part to Product	SAM	Notes	05508-60201	CONTR 1 CBL ASSY		CONTR 1 CBL ASSY
Part to Product	SAM	Notes	05508-60202	ANALOG HPIB CBL ASSY		ANALOG HPIB CBL ASSY
Part to Product	SAM	Notes	05508-60203	LASER PWR CBL ASSY		LASER PWR CBL ASSY
Part to Product	SAM	Notes	05508-60204	PWR AC CBL ASSY		PWR AC CBL ASSY
Part to Product	SAM	Notes	05508-60205	REG CBL ASSY		REG CBL ASSY
Part to Product	SAM	Notes	05508-60206	TRANSFORMER		TRANSFORMER
Part to Product	SAM	Notes	05508-60208	FAN CBL ASSY		FAN CBL ASSY
Part to Product	SAM	Notes	05508-60209	METER CBL AY		METER CBL AY
Part to Product	SAM	Notes	05508-60210	ORDER 05508-60211		FIRMWARE UPDATE KIT
Part to Product	SAM	Notes	05508-60211	EPROM KIT		EPROM KIT
Part to Product	SAM	Notes	05508-60212	CABLE ADAPTOR, REMOTE		CABLE ADAPTOR, REMOTE
Part to Product	SAM	Notes	05508-60301	HINGE, PC BD		HINGE, PC BD
Part to Product	SAM	Notes	05508-80005	EPROM, A2 U5		EPROM, A2 U5
Part to Product	SAM	Notes	05508-80006	EPROM, A2 U6		EPROM, A2 U6
Part to Product	SAM	Notes	05508-80007	EPROM, A2 U7		EPROM, A2 U7
Part to Product	SAM	Notes	05508-80008	EPROM, A2 U8		EPROM, A2 U8
Part to Product	SAM	Notes	05508-80009	EPROM, A2 U9		EPROM, A2 U9
Part to Product	SAM	Notes	05508-80012	EPROM, A2U5		EPROM, A2U5
Part to Product	SAM	Notes	05508-80013	INSULATOR, PC BOARD		INSULATOR, PC BOARD
Part to Product	SAM	Notes	05508-90015	MANUAL, INSTALL PROC		MANUAL, INSTALL PROC
Part to Product	SAM	Notes	05508-90016	PACKING, LIST	NOT NEED FOR SUPPORT	PACKING, LIST

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	**05508-60001**	**6**	**1**	**A1 KEYBOARD / DISPLAY BOARD (DATE CODE 91212)**	**28480**	**05508-60001**
A1C1	0160-4554	7	8	CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C2	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C3	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C4	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C5	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C6	0180-2929	8	9	CAPACITOR-FXD 68UF +-10% 10VDC TA	28480	0180-2929
A1C7	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C8	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C9	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C10	0180-2929	8		CAPACITOR-FXD 68UF +-10% 10VDC TA	28480	0180-2929
A1DS1	1990-0681	3	1	DISPLAY-AN-SEG 1-CHAR .408-H RED	28480	5062-7656
A1DS2	1990-0574	3	9	DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7651
A1DS3	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7651
A1DS4	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7651
A1DS5	1990-0665	3	5	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR-5V	28480	1990-0665
A1DS6	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7651
A1DS7	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR-5V	28480	1990-0665
A1DS8	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7651
A1DS9	1990-0699	3	1	LED-LIGHT BAR MODULE LUM-INT=7MCD	28480	1LM1-2350
A1DS10	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR-5V	28480	1990-0665
A1DS11	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7651
A1DS12	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7651
A1DS13	1990-0696	0	4	LED-LIGHT BAR MODULE LUM-INT=3MCD	28480	1LM1-2300
A1DS14	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR-5V	28480	1990-0665
A1DS15	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7651
A1DS16	1990-0696	0		LED-LIGHT BAR MODULE LUM-INT=3MCD	28480	1LM1-2300
A1DS17	1990-0665	3		LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR-5V	28480	1990-0665
A1DS18	1990-0574	3		DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7651
A1DS19	1990-0696	0		LED-LIGHT BAR MODULE LUM-INT=3MCD	28480	1LM1-2300
A1DS20	1990-0696	0		LED-LIGHT BAR MODULE LUM-INT=3MCD	28480	1LM1-2300
A1DS21	1990-0487	7	1	LED-LAMP LUM-INT=1MCD IF=20MA-MAX BVR=5V	28480	5082-4584
A1J1	1251-6705	8	1	CONNECTOR 50-PIN M POST TYPE	28480	1251-6705
A1J2	1251-3618	6	1	CONNECTOR- 2-PIN M POST TYPE	28480	12513618
A1R1	1810-0277	3	1	NETWORK-RESISTOR 10-SIP 2.2K OHM X 9	01121	210222
A1R2	0698-0082	7	1	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-TO-4640F
A1R3	0698-3442	9	1	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-TO-237R-F
A1S13	5060-9436	7	25	SWITCH-PUSHBUTTON (7)	28480	5060-9436
	5041-0751	1	1	KEY-BUTTON - 7	28480	5041-0751
A1S14	5060-9436	7		SWITCH-PUSHBUTTON (ANGLE)	28480	5060-9436
	5041-0254	9	5	KEY-BUTTON -LIGHT PIPE	28480	5041-0254
A1S15	5060-9436	7		SWITCH-PUSHBUTTON (3)	28480	5060-9436
	5041-0828	3	1	KEY-BUTTON - 3	28480	5041-0828
A1S16	5060-9436	7	1	SWITCH-PUSHBUTTON (8)	28480	5060-9436
	5041-0752	2	1	KEY-BUTTON - 8	28480	5041-0752
A1S17	5060-9436	7		SWITCH-PUSHBUTTON (LONG)	28480	5060-9436
	5041-0254	9		KEY-BUTTON - LIGHT PIPE	28480	5041-0254
A1S18	5060-9436	7		SWITCH-PUSHBUTTON (4)	28480	5060-9436
	5041-0748	6	1	KEY-BUTTON - 4	28480	5041-0748
A1S19	5060-9436	7		SWITCH-PUSHBUTTON (9)	28480	5060-9436
	5041-0753	3	1	KEY-BUTTON - 9	28480	5041-0753
A1S20	5060-9436	7		SWITCH-PUSHBUTTON (SHORT)	28480	5060-9436
	5041-0254	9		KEY-BUTTON- LIGHT PIPE	28480	5041-0254
A1S21	5060-9436	7		SWITCH-PUSHBUTTON (5)	28480	5060-9436
	5041-0749	7	1	KEY-BUTTON - 5	28480	5041-0749
A1S22	5060-9436	7		SWITCH-PUSHBUTTON (0)	28480	5060-9436
	5041-0754	4	1	KEY-BUTTON - 0	28480	5041-0754
A1S23	5060-9436	7		SWITCH-PUSHBUTTON (AUTO RECORD)	28480	5060-9436
	5041-2801		1	KEY-BUTTON - AUTO RECORD	28480	5041-1891
A1S24	5060-9436	7		SWITCH-PUSHBUTTON (-)	28480	5060-9436
	5041-0746	4	1	KEY-BUTTON - MINUS	28480	5041-0746

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1S25	5060-9436	7		SWITCH-PUSHBUTTON (.)	28480	5060-9436
	5041-0755	5	1	KEY-BUTTON - DECIMAL POINT	28480	5041-0755
A1U1	1820-4688	9	2	I32293 ICM748IPIAY LED	32293	ICM7218A
A1U2				NOT ASSIGNED		
A1U3	1820-1112	8	1	IC FF TTL LS D-TYPE POS-EDGE TRIG	01295	SN74LS74AN
A1U4	1820-1144	6	1	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A1U5	1820-2244	9	1	IC FF TTL LS D-TYPE POS-EDGE TRIG COM	01295	SN74LS379N
A1U6	1820-1858	9	1	IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A1U7	1820-2102	8	1	IC LCH TTL LS D-TYPE OCTL	01295	SN74LS373N
A1U8	1820-4688	9		IC DRVR CMOS DSPL LED	32293	CM748IPIICM7218A
A1U9	1820-0070	5	1	IC GATE TTL NAND 8-INP	01295	SN7430N
A1U10	1820-2056	1	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS378N
A1XDS1	1200-0638	7	10	SOCKET-14-CONT DIP-SLDR	28480	1200-0638
A1XDS2	1200-0638	7		SOCKET-14-CONT DIP-SLDR	28480	1200-0638
A1XDS3	1200-0638	7		SOCKET-14-CONT DIP-SLDR	28480	1200-0638
A1XDS4	1200-0638	7		SOCKET-14-CONT DIP-SLDR	28480	1200-0638
A1XDS6	1200-0638	7		SOCKET-14-CONT DIP-SLDR	28480	1200-0638
A1XDS8	1200-0638	7		SOCKET-14-CONT DIP-SLDR	28480	1200-0638
A1XDS9	1200-0688	7	3	SOCKET-STRP 11-CONT DIP-SLDR	28480	1200-0688
A1XDS11	1200-0638	7		SOCKET-14-CONT DIP-SLDR	28480	1200-0688
A1XDS12	1200-0638	7		SOCKET-14-CONT DIP-SLDR	28480	1200-0638
A1XDS13	1200-0688	7		SOCKET-STRP 11-CONT DIP-SLDR	28480	1200-0688
A1XDS15	1200-0638	7		SOCKET-14-CONT DIP-SLDR	28480	1200-0638
A1XDS16	1200-0688	7		SOCKET-STRP 11-CONT DIP-SLDR	28480	1200-0688
A1XDS18	1200-0638	7		SOCKET-14-CONT DIP-SLDR	28480	1200-0638
A1XDS19	1200-0688	7		SOCKET-STRP 11-CONT DIP-SLDR	28480	1200-0688
A1XDS20	1200-0688	7		SOCKET-STRP 11-CONT DIP-SLDR	28480	1200-0688
	5041-0826		1	KEY BUTTON , 1	28480	5041-0826
	5041-0827		1	KEY BUTTON, 2	28480	5041-0827
	5041-1890		1	KEY BUTTON, PRESET	28480	5041-1890
	5041-1892		1	KEY BUTTON, RESOL	28480	5041-1892
	5041-1894		1	KEY BUTTON, V.O.L.	28480	5041-1894
	5041-1895		1	KEY BUTTON, DIR SENSE	28480	5041-1895
	5041-1896		1	KEYBUTTON, EXP COEF	28480	5041-1896
	5041-2008		1	KEY BUTTON, MATERIAL TEMPERATURE	28480	5041-2008

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2	05508-60002	7	1	A2 PROCESSOR BOARD ASSEMBLY DATE CODE 91212	28480	05508-60002
A2C1	0180-4134	1	4	CAPACITOR-FXD 22UF 15V TA +-10% UVDC	56289	173D226X9015X
A2C2	0160-4554	7	13	CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C3	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C4	0180-4134	1		CAPACITOR-FXD 22UF 15V TA +-10% UVDC	56289	173D226X9015X
A2C5	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C6	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C7	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C8	0180-3775		1	CAPACITOR-FXD .01UF +-20% 50VDC CER	56289	299D686X9010D81
A2C9	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C10	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C11	0160-4786	7	2	CAPACITOR-FXD 27PF +-5% 100VDC CER 0+-30	28480	0160-4786
A2C12	0160-4786	7		CAPACITOR-FXD 27PF +-5% 100VDC CER 0+-30	28480	0160-4786
A2C13	0180-4134	1		CAPACITOR-FXD 22UF 15V TA +-10% UVDC	56289	173D226X9015X
A2C14	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C15	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C16	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C17	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C18	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C19	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C20	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C21	0180-4134	1		CAPACITOR-FXD 22UF 15V TA +-10% UVDC	56289	173D226X9015X
A2C22	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2CR1	1901-1080	1	2	DIODE-SCHOTTKY 1N5817 20V 1A	28480	1901-1080
A2CR2	1901-1080	1		DIODE-SCHOTTKY 1N5817 20V 1A	28480	1901-1080
A2CR3	1901-0539	3	9	DIODE-SM SIG SCHOTTKY	28480	1901-0539
A2CR4	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A2CR5	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A2CR6	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A2CR7	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A2CR8	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A2CR9	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A2CR10	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A2CR11	1901-0539	3		DIODE-SM SIG SCHOTTKY	28480	1901-0539
A2JMP1	1810-0520	9	1	NETWORK-SHUNT 16-PIN DIP; 8 SECTIONS; 1	28480	1810-0520
A2R1	1810-0279	5	4	NETWORK-RES 10-SIP 4.7K OHM X 9	01121	210A472
A2R2	0757-0442	9	8	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A2R3	0757-0394	0	1	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-TO-51R-F
A2R4	1810-0231	9	1	NETWORK-RES 8-SIP 2.2K OHM X 7	01121	208A222
A2R5	0757-0458	7	1	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5112-F
A2R6	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A2R7	1810-0279	5		NETWORK-RES 10-SIP 4.7K OHM X 9	01121	210A472
A2R8	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A2R9	1810-0279	5		NETWORK-RES 10-SIP 4.7K OHM X 9	01121	210A472
A2R10	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A2R11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A2R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A2R13	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3161-F
A2R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A2R15	0757-1093	8	1	RESISTOR 3K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3001-F
A2R16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A2R17				NOT ASSIGNED		
A2R18	1810-0279	5		NETWORK-RES 10-SIP 4.7K OHM X 9	01121	210A472
A2S1	3101-2747	5	2	SWITCH-SL DIP 8-1A 0.1A 30VDC	00779	436393-8
A2S2	3101-2429	0	1	SWITCH-TGL SUBMIN SPDT .02A 20VAC/DC PC	28480	3101-2429
A2S3	3101-2747	5		SWITCH-SL DIP 8-1A 0.1A 30VDC	00779	436393-8
A2TP1 - TP11	1251-4707	6	11	CONNECTOR-SGL CONT PIN .031-IN-BSC-SZ	28480	1251-4707

See introduction to this section for ordering information
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Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2U1	1818-0438	4	2	IC-NMOS 4096 (4K) STAT RAM 450-NS 3-S	01295	TMS2114-45NL
A2U2	1818-0438	4		IC-NMOS 4096 (4K) STAT RAM 450-NS 3-S	01295	TMS2114-45NL
A2U3	1820-2024	3	1	IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A2U4	1820-2075	4	1	IC TRANSCEIVER TTL LS BUS OCTL	01295	SN74LS245N
A2U5	05508-80012	1	1	ROM-PROGRAMMED	28480	05508-80012
A2U6/U10				NOT ASSIGNED		
A2U11	1820-0688	1	1	IC GATE TTL S NAND DUAL 4-INP	01295	SN74S20N
A2U12	1820-2121	1	1	IC ENCODER TTL LS	01295	SN74LS348N
A2U13	1820-2562	4	1	IC NMOS 6803 MPU	28480	1820-2562
A2U14	1820-2102	8		IC LCH TTL LS D-TYPE OCTL	01295	SN74LS373N
A2U15	1820-1425	6	1	IC SCHMITT-TRIG TTL LS NAND QUAD 2-INP	01295	SN74LS132N
A2U16	1820-1205	0	1	IC GATE TTL LS AND DUAL 4-INP	01295	SN74LS21N
A2U17	1820-0683	6	1	IC INV TTL S HEX 1-INP	01295	SN74S04N
A2U18	1820-2424	7	2	IC TRANSCEIVER TTL INSTR-BUS-IEEE-488	04713	MC3447P
A2U19	18 20-1216	3	2	IC DCDR TTL LS 3-TO-8-LIN3 3-INP	01295	SN74LS138N
A2U20	1820-1202	7	1	IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A2U21	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A2U22				NOT ASSIGNED		
A2U23	1820-2424	7		IC TRANSCEIVER TTL INSTR-BUS IEEE-488	04713	MC3447P
A2U24	1820-2119		1	IC MICROPROC-ACCESS NMOS	04713	MC68488L
A2XJMP1				NOT ASSIGNED		
A2XJMP2	1200-0607	0	1	SOCKET-IC 16-CONT DIP CIP-SLDR	28480	1200-0607
A2XU5	1200-0567	1		SOCKET-IC DIP 28-CONT DIP DIP-SLDR	00779	2-641-606-1
A2W1	8159-0005	0	1	RESISTOR-ZERO OHMS 22AWG LEAD DIA	28480	8159-0005
A2Y1	0410-1180	0	1	CRYSTAL-QUARTZ 4.000 MHZ HC-18/U-HLDR	28480	0410-1180
				MISCELLANEOUS A2 PARTS		
MP1	5040-6058	1	2	BAR- SUPPORT	28480	5040-6058
MP2	5040-6058	1		BAR- SUPPORT	28480	5040-6058
MP3	0370-3103	5	2	KNOB 8/32 THRD FEMALE INSRT- BLK PLSTC	28480	0370-3103
MP4	5040-7787	5	2	PC BOARD HINGE-HALF	28480	5040-7787
MP5	0403-0115	4	1	BUMPER FOOT-ADH MTG .5-IN-WD .25-IN-THK	28480	0403-0115
MP6	5040-7787	5	2	PC BOARD HINGE-HALF	28480	5040-7787
MP7	0370-3103	5	2	KNOB 8/32 THRD FEMALE INSERT- BLK PLSTC	28480	0370-3103
	0624-0077		8	SCREW, TAPTITE 4-40 .312-LG POZI PAN HD	00000	ORDER BY DESCRIPTION
	2510-0043		2	SCREW-MACH 8-32 .312-IN-LG POZI PAN HD W/LKWR	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3	**05508-60003**	**8**	**1**	**A3 COUNTER BOARD**	**28480**	**05508-60003**
A3C1	0180-4130	7	2	CAPACITOR-FXD 2.2UF 20V TA	56289	173D225X9020V
A3C2	0160-4554	7	51	CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C3	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C4	0160-4557	0	15	CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X74104M050A
A3C5	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C6	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C7	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C8	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C9	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C10	0180-4134	1	2	CAPACITOR-FXD 22UF 15V TA	56289	173D226X9015X
A3C11	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C12	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C13	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C14*	0160-3874	2	2	CAPACITOR-FXD 19PF ±5% 200VDC CER	28480	0160-3874
A3C15	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C16	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C17	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C18	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C19	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C20	0160-4799	2	4	CAPACITOR-FXD 2.2PF ±.25PF 100VDC CER	28480	0160-4799
A3C21	0160-4799	2		CAPACITOR-FXD 2.2PF ±.25PF 100VDC CER	28480	0160-4799
A3C22	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C23	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C24	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C25	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C26	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C27	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X74104M050A
A3C28	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C29	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X74104M050A
A3C30	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C31	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C32	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C33	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C34	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C35	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C36	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C37	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C38	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C39	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X74104M050A
A3C40	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C41	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C42	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C43	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C44	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X74104M050A
A3C45	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X74104M050A
A3C46	0180-4134	1		CAPACITOR-FXD 22UF 15V TA	56289	173D226X9015X
A3C47	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C48	0160-4265	7	2	CAPACITOR-FXD .47UF ±20% 50VDC	84411	HEW 388
A3C49	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C50	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C51	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C52	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C53	0160-3874			CAPACITOR-FXD 10PF ±5% 200VDC CER	28480	0160-3874
A3C54	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C55	0160-4799	2		CAPACIATOR-FXD 2.2PF ±.25PF 100VDC CER	28480	0160-4799
A3C56	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C57	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C58	0180-4130	7		CAPACITOR-FXD 2.2UF 20V TA	56289	173D225X9020V
A3C59	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C60	0160-4799	2		CAPACITOR-FXD 2.2PF ±.25PF 100VDC CER	28480	0160-4799

See introduction to this section for ordering information
*Indicates factory-selected value.

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3C61	0160-4265	7		CAPACITOR-FXD .47UF ±20% 50VDC	84811	HEW 386
A3C62	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A2C63	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C64	0160-3702	5	1	CAPACITOR-FXD .027UF ±5% 50VDC	28480	0160-3702
A3C65	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C66	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C67	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C68	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X74104M050A
A3C69	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C70	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X74104M050A
A3C71	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X74104M050A
A3C72	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X74104M050A
A3C73	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X74104M050A
A3C74	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X74104M050A
A3C75	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X74104M050A
A3C76	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X74104M050A
A3C77	0160-4557	0		CAPACITOR-FXD .1UF ±20% 50VDC CER	16299	CAC04X74104M050A
A3C78	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3C79	0160-4554	7		CAPACITOR-FXD .01UF ±20% 50VDC CER	28480	0160-4554
A3CR1 - CR5	1901-0040	1	17	DIODE-SWITCHING 30V 50MA 2NS D0-35	28480	1901-0040
A3CR6				NOT ASSIGNED		
A3CR7 - CR18	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3DS1 - DS2	1990-0646	0	2	LED-LAMP LUM-INT=1MCD IF=13MA-MAX	28480	HLMP-6600
A3J1 - J5	1251-4682	6	5	CONNECTOR 3-PIN M-POST TYPE	28480	1251-4682
A3R1	0698-3279	0	4	RESISTOR 4.99K 1% .125W TF TC=0±100	2M627	CRB14 OR CRB25
A3R2	0757-0180		2	RESISTOR 31.6% .125W F TC=0±100	28480	0757-0180
A3R3	0698-3279	0		RESISTOR-FXD 4.99K 1% .125W FTF TC=0±10	2M627	CRB14 OR CRB25
A3R4	0698-0082	7	4	RESISTOR 464 1% .125W F TC=0±100	24546	C4-1/8-T0-4640-F
A3R5	1810-0364	9	6	NETWORK RESISTOR 6-SIP 470.0 OHM X 5	01121	206A471
A3R6	1810-0364	9		NETWORK RESISTOR 6-SIP 470.0 OHM X 5	01121	206A471
A3R7	0757-0441	8	4	RESISTOR 8.25K 1% .125W F TC=0±100	24546	C4-1/8-TO-8251-F
A3R8	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=-0±100	24546	C4-1/8-T0-8251-F
A3R9	0698-3438	3	4	RESISTOR 147 1% .125W F TC-0±100	24546	C4-1/8-TO-147R-F
A3R10	0698-3438	3		RESISTOR 147 1% .125W F TC-0±100	24546	C4-1/8-TO-147R-F
A3R11	1810-0203	5	4	NETWORK RESISTOR 8-SIP 470.0 OHM X 7	01121	208A471
A3R12	1810-0203	5		NETWORK RESISTOR 8-SIP 470.0 OHM X 7	01121	208A471
A3R13	1810-0364	9		NETWORK RESISTOR 6-SIP 470.0 OHM X 5	01121	206A471
A3R14	0757-0283	6	3	RESISTOR 2K 1% .125W F TC=0±100	24546	C4-1/8-T0-2001-F
A3R15	0698-3445	2	6	RESISTOR 348 1% .125W F TC=0±100	24546	C4-1/8-TO-348R-F
A2R16	0698-3445	2		RESISTOR 348 1% .125W F TC=0±100	24546	C4-1/8-TO-348R-F
A3R17	0757-0442	9	5	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-1002-F
A3R18	0757-0401	0	2	RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-TO-101-F
A3R19	0757-0283	6		RESISTOR 2K 1% .125W F TC=0±100	24546	C4-2/8-TO-2001F
A3R20	0698-3445	2		RESISTOR 348 1% .125W F TC=0±100	24546	C4-1/8-TO-348R-F
A3R21	0698-3445	2		RESISTOR 348 1% .125W F TC=0±100	24546	C4-1/8-TO-348R-F
A3R22	0757-0316	6	2	RESISTOR 42.2 1% .125W F TC=0±100	24546	C4-1/8-TO-42R2-F
A3R23	0698-0082	7		RESISTOR 464 1% .125W F TC=0±100	24546	C4-1/8-TO-4640-F
A3R24	0757-0401	0		RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-TO-101-F
A3R25	0757-0316	6		RESISTOR 42.2 1% .125W F TC=0±100	24546	C4-1/8-TO-42R2-F
A3R26	0698-0082	7		RESISTOR 464 1% .125W F TC=0±100	24546	C4-1/8-TO-4640-F
A3R27	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-1002-F
A3R28	1810-0204	6	1	NETWORK RESISTOR 8-SIP 1.0K OHM X 7	01121	208A102
A3R29	0757-0449	6	2	RESISTOR 20K 1% .125W F TC=0±100	24546	C4-1/8-TO-2002-F
A3R30	0698-3279	0		RESISTOR-FXD 4.99K 1% .125W TF TC=0±100	2M627	CRB14 OR CRB25
A3R31	0698-3442	9		RESISTOR 237 1% .125W F TC-0±100	24546	C4-18-TO-237R-F
A3R32	0698-3279	0		RESISTOR-FXD 4.99K 1% .125W TF TC=0±100	2M627	CRB14 OR CRB25
A3R33	0757-0449	6		RESISTOR 20K 1% .125W F TC=0±100	24546	C4-1/8-TO-2002-F
A3R34	0757-0283	6		RESISTOR 2K 1% .125W F TC=0±100	24545	C4-1/8-T0-2001-F
A3R35	1810-0203	5		NETWORK RESISTOR 8-SIP 470.0 OHM X 7	01121	208A471

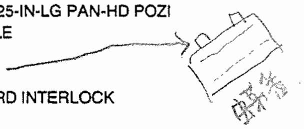
See introduction to this section for ordering information
*Indicates factory-selected value.

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R36	1810-0203	5		NETWORK RESISTOR 8-SIP 470.0 OHM X 7	01121	208A471
A3R37	1810-0364	9		NETWORK RESISTOR 8-SIP 470.0 OHM X 5	01121	206A471
A3R38	0698-3445	2		RESISTOR 348 1% .125W F TC=0±100	24546	C4-1/8-TO-348R-F
A3R39	0698-3445	2		RESISTOR 348 1% .125W F TC=0±100	24546	C4-1/8-TO-348R-F
A3R40	1810-0364	9		NETWORK RESISTOR 8-SIP 470.0 OHM X 5	01121	206A471
A3R41	1810-0364	9		NETWORK RESISTOR 8-SIP 470.0 OHM X 5	01121	206A471
A3R42	1810-0371	8	2	NETWORK RESISTOR 8-SIP 100K OHM X 7	01121	208A104
A3R43	0698-0082	7		RESISTOR 464 1% .125W F TC=0±100	24546	C4-1/8-T0-4640-F
A3R44	0698-3438	3		RESISTOR 147 1% .125W F TC-0±100	24546	C4-1/8-TO-147R-F
A3R45	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=-0±100	24546	C4-1/8-T0-8251-F
A3R46	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=-0±100	24546	C4-1/8-T0-8251-F
A3R47	0757-0458	7	1	RESISTOR 51.1K 1% .125W TF TC=0±100	2M627	CRB14 OR CRB25
A3R48	0698-3438	3		RESISTOR 147 1% .125W F TC=0±100	24546	C4-1/8-TO-147R-F
A3R49	1810-0371	8		NETWORK RESITOR 8-SIP 100K OHM X 7	01121	208A104
A3R50	1810-0498	0	1	NETWORK RESISTOR 4-SIP MULTI-VALUE	28480	1810-0498
A3R51	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A3R52	0698-6944	2	1	RESISTOR 35K 1% .125W F TC=0±25	28480	0698-6944
A3R53	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-1002-F
A3R54	0757-0442	9		RESISTOR 10K 1% .125F F TC=0±100	24546	C4-1/8-TO-1002-F
A3R55	1810-0398	9	2	NETWORK RESISTOR 10-SIP 22K OHM X 9	11236	750-1010-R22K
A3R56	1810-0210	4	1	NETWORK RESISTOR 14-DIP 300 OHM X 7	01121	314B301
A3R57 - R59				NOT ASSIGNED		
A3R60	1810-0398	9		NETWORK RESISTOR 10-SIP 22K OHM X 9	11236	750-1010-R22K
A3R61	0757-1108	6	1	RESISTOR 300 1% .125W F TC=0±100	24546	C4-1/8-T0-301-F
A3R62	0757-0709	1	1	RESISTOR 68.1 1% .25W F TC=0±100	24546	C5-1/4-TO-68R1-F
A3S1 – S2	3101-1856	5	2	SWITCH-SL 8-1A DIP-SLIDE-ASSY .1A 50VDC	28480	3101-1856
A3TP1 - TP40	0360-0124	3	40	CONNECTOR- SGL CONT PIN .04-IN-BSC-SZ RN	28480	0360-0124
A3U1	1820-1430	3	6	IC-CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161AN
A3U2	1820-1430	3		IC-CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161AN
A3U3	1820-0803	2	4	IC GATE ECL OR-NOR TPL	04713	MC10105P
A3U4	1820-3126	8	4	IC CNTR ECL HEXADEC SYNCHRO	04713	MC10136P
A3U5	1820-0817	8	4	IC FF ECL D-M/S DUAL	04713	MC10131P
A3U6	1826-0180	0	1	IC TIMER TTL MONO/SASTBL	18324	NE555N
A3U7	1820-1997	7	4	IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	34335	AM74LS374AP
A3U8	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161AN
A3U9	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A3U10	1820-3126	8		IC CNTR ECL HEXADEC SYNCHRO	04713	MC10136P
A3U11	1820-1632	7	2	IC CNTR ECL BIN ASYNCHRO POS-EDGE-TRIG	04713	MC10178P
A3U12	1820-0782	8	2	IC PL LOOP	28480	1826-0782
A3U13	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	34335	AM74LS374AP
A3U14	1820-2144	8	4	IC RCVR TTL LINE RCVR QUAD	04713	MC3486P
A3U15	1820-2144	8		IC RCVR TTL LINE RCVR QUAD	04713	MC3486P
A3U16	1820-0803	2		IC GATE ECL OR-NOR TPL	04713	MC10105P
A3U17	1820-1399	3	2	IC FF ECL D-TYPE COM CLOCK HEX	04713	MC10176P
A3U18	1820-1344	8	2	IC PL LOOP 14-DIP C PKG	04713	MC12040L
A3U19	1820-2244	9	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS379N
A3U20	1820-0683	6	2	IC INV TTL S HEX 1-INP	01295	SN74S04N
A3U21	1820-1272	1	1	IC BFR TTL LS NOR QUAD 2-INP	01295	SN74LS33N
A3U22	1820-1112	8	6	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U23	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U24	1820-1207	2	1	IC GATE TTL LS NAND 8-INP	01295	SN74LS30N
A3U25	1820-0809	8	1	IC RCVR ECL LINE RCVR QUAD 2-INP	04713	MC10115P
A3U26	1820-2024	3	4	IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A3U27	1820-1216	3	2	IC DCDR TTL LS 3-TO-8 LINE 3-INP	01295	SN74LS138N
A3U28	1820-1200	5	1	IC INV TTL LS HEX	01295	SN74LS05N
A3U29	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U30	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U31	1826-0139	9	1	IC OP AMP GP DUAL 8-DIP-P PKG	3L585	CA1458G
A3U32	1820-1423	4	1	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
A3U33	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	34335	AM74LS2374AP

See introduction to this section for ordering information
*Indicates factory-selected value.

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3U34	1820-2144	8		IC RCVR TTL LINE RCVR QUAD	04713	MC3486P
A3U35	1820-2144	8		IC RCVR TTL LINE RCVR QUAD	04713	MC3486P
A3U36	1820-0803	2		IC GATE ECL OR-NOR TPL	04713	MC10105P
A3U37	1820-1399	3		IC FF ECL D-TYPE COM CLOCK HEX	04713	MC101076P
A3U38	1820-1344	8		IC PL LOOP 14-DIP-C PKG	04713	MC12040L
A3U39	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE TRIG PRL-IN	34335	AM74LS374AP
A3U40	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161AN
A3U41	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A3U42	1820-3126	8		IC CNTR ECL HEXADEC SYNCHRO	04713	MC10136P
A3U43	1820-1632	7		IC CNTR ECL BIN ASYNCHRO POS-EDGE-TRIG	04713	MC10178P
A3U44	1826-0782	8		IC PL LOOP	28480	1826-0782
A3U45	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161AN
A3U46	1820-1430	3		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS161AN
A3U47	1820-0803	2		IC GATE ECL OR-NOR TPL	04713	MC10105P
A3U48	1820-3126	8		IC CNTR ECL HEXADEC SYNCHRO	04713	MC10136P
A3U49	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A3U50	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A3U51	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A3U52	1820-0683	6		IC INV TTL 5 HEX 1-INP	01295	SN74504N
A3U53	1820-1201	6	1	IC GATE TTL LS AND QUAD W-INP	01295	SN74LS08N
A3U54	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U55	1820-2096	9	1	IC CNTR TTL LS BIN DUAL 4-BIT	01295	SN74LS393N
A3U56	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A3U57	1826-0065	0	1	IC COMPARATOR PRCN 8-DIP-P PKG	S0545	UPC311C
A3U58	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A3U59	1820-2056	1	1	IC FF TTL LS D-TYPE POS-EDGE TRIG COM	01295	SN74LS378N
A3U60	1820-1795	3	2	IC ANALOG SWITCH 4-SPST 16-DIP-P	27014	LF13331N
A3U61	1826-0285	6	1	IC V RGLTR TO-92	04713	MC79L05C
A3U62	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A3U63	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A3U64	1260-0510	0	1	IC PACKAGE	28480	1260-0510
A3U65	1826-1053	8	1	A/D 12-BIT 40-DIP-C CMOS	15818	7109IDL
A3U66	1820-1795	3		IC ANALOG SWITCH 4-SPST 16-DIP-P	27014	LF13331N
A3U67	1826-0965	9	1	IC-AD 584KH	28480	1826-0965
				MISCELLANEOUS A3 PARTS		
	0340-0060	4	3	TERMINAL-STUD SPCL-FEEDTHRU PRESS MTG	98291	011 6809 000 209
	0340-0092	2	3	TERMINAL-STUD SPCL-FDTHRU PRESS-MTG	28480	0340-0092
	0380-0630		2	SPACER- SNAP-PIN .75-LG	28480	0380-0630
	0624-0077	5	8	SCREW-TPG 4-40 .312-IN-LG PAN-HD-POZI	28480	0624-0077
	0624-0078		2	SCREW-TPG 6-32 .375-IN-LG PAN-HD POZI	00000	ORDER BY DESCRIPTION
	2360-0113	2	2	SCREW-MACH 6-32 .25-IN-LG PAN-HD POZI	00000	ORDER BY DESCRIPTION
	1258-0141		5	JUMPER, REMOVABLE	28480	1258-0141
	5040-6058	1	2	BAR- SUPPORT	28480	5040-6058
	5040-7721	7	2	HINGE- PC BOARD 	28480	5040-7721
	05508-20307	1	2	FASTENER- PC BOARD INTERLOCK	28480	05508-20307
A4	**05508-60004**	**9**	**1**	**A4 CONNECTOR BOARD ASSEMBLY**	**28480**	**05508-60004**
A4C1–C9	0160-3879	7	9	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4CR1	1902-3182	0	1	DIODE-ZNR 12.1V 5% DO-35 PD=.4W	28480	1902-3182
A4J1	1251-6706	9	1	CONNECTOR 26-PIN M POST TYPE	28480	1251-6706
A4J2 - J4	1251-6703	6	3	CONNECTOR 6-PIN F CIRCULAR	28480	1251-6703
A4J5	1251-6702	5	1	CONNECTOR 10-PIN F CIRCULAR	28480	1251-6702
A4J6	1251-4740	7	1	CONNECTOR 14-PIN M POST TYPE	28480	1251-4740
A4J7	1251-8247	7	1	CONNECTOR 4-PIN F CIRCULAR	28480	1251-8247
A4J8	1251-7180	5	1	CONNECTOR 18-PIN F CIRCULAR	28480	1251-7180
A4R1	1810-0368	3	1	NETWORK RESISTOR 6-SIP 10.0K OHM X 5	01121	206A103
A4R2 - R3	0757-0399	5	2	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-TO-82R5-F
A4S1	3101-2411	0	1	SWITCH-TGL SUBMIN SPDT .02A 20VAC/DC PC	28480	3101-2411
	0380-0896	8	12	STANDOFF-RVT-ON .438-IN-LG 4-40 THD	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information
*Indicates factory-selected value.

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5	**05508-60005**	**0**	**1**	**A6 POWER SUPPLY (SERIES 2628)**	**28480**	**05508-60005**
A5C1	0180-3579	6	1	CAPACITOR-FXD 500UF +75-10% 63VDC AL	28480	0180-3579
A5C2	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A5C3	0160-0049	9	2	CAPACITOR-FXD 20UF +75-10% 50VDC AL	56289	30D206G050CC2
A5C4	0160-4812	0	2	CAPACITOR-FXD 220PF +-5% 100VDC CER	28480	0160-4812
A5C5	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A5C6	0160-4557	0	4	CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A5C7	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	162999	CAC04X7R104M050A
A5C8	0160-0049	9		CAPACITOR-FXD 20UF +75-10% 50VDC AL	56289	30D206G050CC2
A5C9	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A5C10	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A5C11	0180-3238	4	1	CAPACITOR-FXD 25.000UF	28480	0180-3238
A5C12	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A5C13	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A5C14	0160-4812	0		CAPACITOR-FXD 220PF +-5% 100VDC CER	28480	0160-4812
A5C15	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A5C16	0180-3419	3	1	CAPACITOR-FXD .01UF +75-10% 75VDC AL	28480	0180-3419
A5CR1	1901-0040	1	3	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR2	1901-0731	7	4	DIODE-POWER RECT 400V 1A	28480	1901-0731
A5CR3	1901-0731	7		DIODE-POWER RECT 400V 1A	28480	1901-0731
A5CR4				NOT ASSIGNED		
A5CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS	28480	1901-0040
A5CR6	1902-0049	2	2	DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A5CR7	1902-0049	2		DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A5CR8	1902-0074		1	DIODE-ZENER 7.15V 5% DO-35 PD=.4W	28480	1901-0074
A5CR9				NOT ASSIGNED		
A5CR10	1901-0731	7		DIODE-POWER RECT 400V 1A	28480	1901-0731
A5CR11	1901-0731	7		DIODE-POWER RECT 400V 1A	28480	1901-0731
A5CR12	1902-0522	6	1	DIODE-ZNR 1N5340B 6V 5% PD=5W IR=1UA	04713	1N5340B
A5CR13	1902-0632	9	1	DIODE-ZNR 1N534B 17V 5% PD=5W TC=+75%	04713	1N534B
A5CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR15	1901-0692	9	2	DIODE-PWR RECT 200V 3A 200NS	04713	MR852
A5CR16	1901-0692	9		DIODE-PWR RECT 20V 3A 200NS	04713	MR852
A5CR17	1902-0184	6	1	DIODE-ZNR 16.2V 5% DO-35 PD=.4W	28480	1902-0184
A5DS1	1990-0487	7	2	LED-LAMP LUM-INT=1MCD IF=200MA-MAX BVR=5V	28480	5082-4584
A5DS2	1990-0485	5	2	LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	5082-4984
A5DS3	1990-0487	7		LED-LAMP LUM-INT=1MCD IF=200MA-MAX BVR=5V	28480	5082-4584
A5DS4	1990-0485	5		LED-LAMP LUM-INT=800UCD IF=30MA-MAX	28480	5082-4984
A5F1	2110-0010	9	2	FUSE 5A 250V NTD 1.25X.25 UL	75915	312005
A5F2	2110-0010	9		FUSE 5A 250V NTD 1.25X.25 UL	75915	312005
A5J1	1251-6705	8	1	CONNECTOR 50-PIN M POST TYPE	28480	1251-6705
A5J3	1251-4740	7	1	CONNECTOR 14-PIN M POST TYPE	28480	1251-4740
A5J4	1251-5522	5	1	CONNECTOR 8-PIN M POST TYPE	28480	1251-5522
A5J5	1251-6999	2	1	CONNECTOR 15-PIN M POST TYPE	28480	1251-6999
A5Q1	1854-0215	1	2	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A5Q2	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A5R1				NOT ASSIGNED		
A5R2	0757-0280	3	6	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A5R3	0698-3444	1	2	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-TO-316R-F
A5R4	0757-0198	2	1	RESISTOR 100 1% .5W F TC=0+-100	28480	0757-0198
A5R5	0811-3499	8	2	RESISTOR .07 3% 52 PW TC=0+-90	28480	0811-3499
A5R6				NOT ASSIGNED		
A5R7	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A5R8	0757-0458	7	3	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5112-F
A5R9	0757-0458			RESISTOR 51.1K +-1% .125W F TC=0+-100	24546	C4-1/8-TO-5112-F
A5R10				NOT ASSIGNED		

See introduction to this section for ordering information
*Indicates factory selected value.

Table 6-3. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5R11				NOT ASSIGNED		
A5R12	0698-0084	9	2	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2151-F
A5R13	0757-0465	6	2	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1003-F
A5R14	0698-3155	1	1	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-TO-4641-F
A5R15	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A5R16	0698-3162	0	1	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C4-1/8-TO-4642-F
A5R17				NOT ASSIGNED		
A5R18	0811-3499	8		RESISTOR .07 3% SW PW TC=0+-90	28480	0811-3499
A5R19	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A5R20				NOT ASSIGNED		
A5R21	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	CR-1/8-TO-1001-F
A5R22	0757-0288	1	1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-TO-9091-F
A5R23	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1003-F
A5R24	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-TO-316R-F
A5R25	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-TO-7501-F
A5R26				NOT ASSIGNED		
A5R27	0757-0438	3	1	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5111-F
A5R28	0757-0442	9	·	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A5R29	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A5R30	0698-5575	3	1	RESISTOR 100K 5% .125W F TC=0+-100	24546	C4-1/8-TO-1003-D
A5R31	0757-0734	2	1	RESISTOR 1.21K 1% .25W F TC=0+-100	28480	0757-0734
A5R32	0698-3441	8	1	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-TO-215R-F
A5R33	0757-0458			RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8/TO-5112-F
A5R34	0698-3430	5	1	RESISTOR 21.5 1% .125W F TC=0+-100	03888	PMESS-1/8-TO-21R5-5
A5R35	0698-0084	9		RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2151-F
A5TP1 -TP5	0360-0124	3	5	CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ-RND	28480	0360-0124
A5U1	1826-0650	9	1	IC VOLT-REG ADJ 2.5/10V TO-99 PKG	28480	1826-0650
A5U2	1826-1460	1	2	IC OP AMP GP 8-DIP-P PKG	04713	LM201AN
A5U3	1820-0214	1	1	IC V-REGULATOR TO-220	04713	MC7915CT
A5U4	1820-0493	6	1	IC OP AMP GP 8-DIP-P PKG	27014	LM307N
A5U5	1826-1460	1		IC OP AMP GP 8-DIP- PKG	27014	LM201AN
A5U6	1826-0607	6	1	IC-REGULATOR 7815A	28480	1826-0607
A5XF1 - F2	2110-0269	0	2	FUSEHOLDER-CLIP TYPE .25D-FUSE	28480	2110-0269
				MISCELLANEOUS A5 PARTS		
	1205-0403	4	2	HEAT SINK SGL TO-220-CS	28480	1205-0403
	2190-0018	5	2	WASHER-LK HLCL NO 6 .141-IN-ID	28480	2190-0018
	2190-0034	5	4	WASHER-LK HLCL NO 10 .194-IN-ID	28480	2190-0034
	2420-0003	7	2	NUT-HEX DBL-CHAM 6-32-THD .094-IN-THK	28480	2420-0003
	2680-0127	6	4	SCREW-MACH 10-32 .312-IN-LG	00000	ORDER BY DESCRIPTION
	1400-0694	9	1	CLAMP-FL CA .75-WD NYLON	28480	1400-0694
A6	**05508-60021**	**0**	**1**	**A6 REMOTE CONTROL UNIT (SERIES 2108)**	**28480**	**05508-60021**
A6A1	05508-60020	9	1	REMOTE CONTROL PC BOARD ASSEMBLY	28480	05508-60020
A6A1C1	0180-4130		1	CAPACITOR-FXD 2.2UF 20V TA	56289	173D225X9020V
A6A1C2	0160-4557	0	2	CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A6A1C3	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X74104M050A
A6A1CR1	1902-3070	5	1	DIODE-ZENER 4.22V 5% DO-35 -D=.4W	28480	1902-3070
A6A1R1	0757-0428	1	1	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1621-F
A6A1R2	0757-0394	0	1	RESISTOR 51.1 1% 125W F TC=0+-100	24546	C4-1/8-TO-51R1-F
A6A1S1	3101-2489	2	2	SWITCH-RKR SUBMIN SPDT .02A 20VAC/DC PC	28480	3101-2489
A6A1S2	3101-2489	2		SWITCH-RKR SUBMIN SPDT .02A 20VAC/DC PC	28480	3101-2489
				FOR 5508A MISCELLANEOUS AND CHASSIS PARTS- SEE FIGURES 6-1 THROUGH 6-8		

See introduction to this section for ordering information
*Indicates factory selected value.

Table 6-4. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	**05518-60001**	**8**	**1**	**A1 CONNECTOR BOARD ASSY (DATE CODE 90232)**	**28480**	**05518-60001**
A1C1	0160-4557	0	3	CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C2	0180-4132	9	1	CAPACITOR-FXD 6.8UF 35V TA	56289	173D685X9035X
A1C3	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	04222	C420C104M5R5CA
A1C4	0180-2867	3	1	CAPACITOR-FXD 390UF +100-10% 40VDC AL	28480	0180-2867
A1C5	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	04222	C420C104M5R5CA
A1CR1	1901-0731	7	1	DIODE- PWR RECT 400V 1A	28480	1901-0731
A1CR2	1902-0632	9	1	DIODE-ZNR 1N5354B 17V 5% PD=5W TC=+75%	04713	1N5354B
A1DS1 - DS2	1990-0895	1	2	LED-LAMP LUM-INT=80MCD IF=100UA-MAX	28480	1990-0895
A1F1	2110-0007	4	1	FUSE 1A 250V TD 1.25X.25UL	75915	313001
A1J1	1251-6777	4	1	CONNECTOR 20-PIN F POST TYPE	28480	1251-6777
A1J2	1251-7180	5	1	CONNECTOR 18-PIN F CIRCULAR	28480	1251-7180
A1J3	1251-6010	8	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-6010
A1J4	1251-5170	9	1	CONNECTOR 2-PIN M POST TYPE	28480	1251-5170
A1R1	0757-0338	2	2	RESISTOR 1K 1% .25W F TC=0+-100	24546	C5-1/4-TO-1001-F
A1R2	0757-0338	2		RESISTOR 1K 1% .25W F TC=0+-100	24546	C5-1/4-TO-1001-F
A1R3	2100-3274	2	1	RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A1R4	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3161-F
A1S1 - S2				REPLACED BY JUMPER WIRE (P/N 8159-0005)		
A1XF1	2110-0269	0	2	FUSEHOLDER-CLIP TYPE .25D-FUSE	28480	2110-0269
				MISCELLANEOUS A1 PARTS		
	0380-1548	9	4	STANDOFF-RIVET 10 LM 2.5	28480	0380-1548
	4040-1614	4	2	STANDOFF-LED	28480	4040-1614
A2	**05518-60002**	**9**	**1**	**A2 RECEIVER BOARD ASSY (SERIES 2236)**	**28480**	**05518-60002**
A2C1	0160-4554	7	3	CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C2	0160-4557	0	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A2C3	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A2C4	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C5	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A2C6	0180-4129	4	1	CAPACITOR-FXD 1UF 35V TA	56289	173D105X9035V
A2C7	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A2C8	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A2C9	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A2CR2	1901-0518	8	1	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A2CR3	1990-0770	1	1	PHOTODIODE ID=30NA-MAX	32694	OP 913 (SELECTED)
A2DS1 - DS2	1990-0895	1	2	LED-LAMP LUM-INT=80MCD IF=100UAMAX	28480	1990-0895
A2J1	1251-5170	9	1	CONNECTOR 2-PIN M POST TYPE	28480	1251-5170
A2J2	1251-6779	6	1	CONNECTOR 10-PIN F POST TYPE	28480	1251-6779
A2Q1	1855-0082	2	1	TRANSISTOR J-FET P-CHAN D-MODE SI	28480	1855-0082
A2Q2	1854-0215	1	1	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2R1	0757-0441	7	1	RESISTOR 8.25K 1% .125W F TC=0+-100	28480	0757-0441
A2R2	0698-8959	3	2	RESISTOR 619K 1% .125W F TC=0+-100	28840	0698-8959
A2R3	2100-3109	2	1	RESISTOR-TRMR 2K 10% C SIDE-ADJ 17-TRN	02111	43P202
A2R4	0698-3160	8	1	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3162-F
A2R5	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-TO-7501-F
A2R6	0698-3444	1	1	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-TO-316R-F
A2R7	0757-0461	2	1	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-6812-F
A2R8	0757-0416	7	3	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A2R9	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A2R10	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F

See introduction to this section for ordering information.
*Indicates factory-selected value.

Table 6-4. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2R11	0698-3155	1	1	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-TO-4641-F
A2R12	0757-0338	2	1	RESISTOR 1K 1% .25W F TC=0+-100	24546	C5-1/4-60-1001-F
A2R13	0698-8959	3		RESISTOR 619K 1% .125W F TC=0+-100	28480	0698-8959
A2TP1	0360-0124	3	1	CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
A2U1	1826-0775	9	1	IC 16-DIP P PKG	28480	1DA7Q
				MISCELLANEOUS A2 PARTS		
	0340-0907	8	1	INSULATOR-TRANSISTOR NYLON	28480	0340-0907
	4040-1614	4	2	STANDOFF-LED	28480	4040-1614
A3	**05518-60003**	**0**	**1**	**A3 CONTROLLER/REFERENCE BD (DATE CODE 91021)**	**28480**	**05518-60003**
A3C1	0180-2929	8	1	CAPACITOR-FXD 68UF +-10% 10VDC TA	28480	0180-2929
A3C2	0160-4554	7	11	CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C3	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C4	0180-4133	0	1	CAPACITOR-FXD 20V TA	56289	173D156X9020X
A3C5	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A3C6	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C7	0180-1735	2	1	CAPACITOR-FXD .22UF +-10% 35VDC TA	56289	150D224X9035A2
A3C8	0160-4812	0	1	CAPACITOR-FXD 220PF +-5% 100VDC CER	28480	0160-4812
A3C9	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C10	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C11	0180-0049	9	2	CAPACITOR-FXD 20UF +70-10% 50VDC AL	56289	30D206G050CC2
A3C12	0180-0049	9		CAPACITOR-FXD 20UF +75-10% 50VDC AL	56289	30D206G050CC2
A3C13	0160-3072	2	2	CAPACITOR-FXD 1UF +-10% 100VDC MET-POLYE	28480	0160-3072
A3C14	0160-3072	2		CAPACITOR-FXD 1UF +-10% 100VDC MET-POLYE	28480	0160-3072
A3C15	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C16	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C17	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C18	0160-2453	1	1	CAPACITOR-FXD .22UF +-10% 80VDC POLYE	28480	0160-2453
A3C19	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-45544
A3C20	0160-5237	5	1	CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-5237
A3C21	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A3C22	0160-0576	5	3	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C23	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A3C24	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A3C25				NOT ASSIGNED		
A3C26	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A3C27	0160-0576	5		CAPACITOR-FXD 1UF +-20% 50VDC CER	28480	0160-0576
A3C28	0180-0309	4	1	CAPACITOR-FXD 4.7UF +-20% 10VDC TA	56289	150D475X0010A2
A3C29	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A3C31	0160-4824	4	1	CAPACITOR-FXD 680PF +-5% 100VDC CER	28480	0160-4824
A3CR1	1901-0040	1	1	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR2	1901-0731	7	1	DIODE-POWER RECT 400V 1A	28480	1901-0731
A3CR3	1902-3059	0	1	DIODE-ZENER 3.83V 5% DO-35 PD=.4W	28480	1902-3059
A3CR4	1902-0551	1	1	DIODE-ZNR 6.2V 5% PD=1W IF=10UA	28480	1902-0551
A3CR5	1990-0770	1	1	PHOTODIODE ID=30NA-MAX	32694	OP 913 (SELECTED)
A3CR6	1901-0518	8	1	DIODE-SM SIG SCHOTTKY	28480	1901-0518
A3J1	1251-4547	2	1	CONNECTOR 20-PIN M POST TYPE	28480	1251-4547
A3J2	1251-5801	3	1	CONNECTOR 4-PIN M POST TYPE	28480	1251-5801
A3J3	1251-6776	3	1	CONNECTOR 10-PIN M POST TYPE	28480	1251-6776
A3JMP1	1251-4047	7	3	CONNECTOR 3-PIN M POST TYPE	28480	1251-4047
A3JMP2	1251-4813	5	3	CONNECTOR 5-PIN M POST TYPE	28480	1251-4813
A3JMP3	1251-6957	2	1	CONNECTOR 4-PIN M POST TYPE	28480	1251-6957
A3JMP4	1251-4813	5		CONNECTOR 5-PIN M POST TYPE	28480	1251-4813
A3JMP5	1251-4047	7		CONNECTOR 3-PIN M POST TYPE	28480	1251-4047
A3JMP6	1251-4813	5		CONNECTOR 5-PIN M POST TYPE	28480	1251-4813
A3JMP7	1251-4047	7		CONNECTOR 3-PIN M POST TYPE	28480	1251-4047

See introduction to this section for ordering information.
*Indicates factory-selected value.

Table 6-4. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3L1	9100-1630	7	2	INDUCTOR RF-CH-MLD 51UH 5% .166DX.385LG	28480	9100-1630
A3L2	9100-1630	7		INDUCTOR RF-CH-MLD 51UH 5% .166DX.385LG	28480	9100-1630
A3L3	9140-0158	6	2	INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A3L4	9140-0158	6		INDUCTOR RF-CH-MLD 1UH 10% .105DX.26LG	28480	9140-0158
A3Q1 - Q2						
A3Q3	1853-0347		1	TRANSISTOR PNP SI DARL PD=40W FT=1MHZ	04713	MJE700
A3Q4				NOT ASSIGNED		
A3Q5	1854-0215	1	2	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q6	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3R1 - R4				NOT ASSIGNED		
A3R5	1810-0279	5	1	NETWORK RESISTOR 10SIP 4.7K OHM X 9	01121	210A472
A3R6	0699-0069	2	4	RESISTOR 2.15M 1% .125W F TC=0+-100	28480	0699-0069
A3R7	0757-0458	7		RESISTOR 51.1K 1% .125W TF TC=0+-100	2M627	CRB14 OR CRB25
A3R8	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-TO-7501-F
A3R9	0757-0814	9	1	RESISTOR 511 1% .5W F TC=0+-100	28480	0757-0814
A3R10	0698-6360	6	4	RESISTOR 10K 1% .125W F TC=0+-25	28480	0698-6830
A3R11	0698-6360	6		RESISTOR 10K 1% .125W F TC=0+-25	28480	0698-6830
A3R12 - R13				NOT ASSIGNED		
A3R14	0698-6360	6		RESISTOR 10K 1% .125W F TC=0+-25	28480	0698-6830
A3R15	0698-6360	6		RESISTOR 10K 1% .125W F TC=0+-25	28480	0698-6830
A3R16	2100-3161	6	1	RESISTOR TRMR 20K 10% C SIDE-ADJ 17-TURN	02111	43P203
A3R17	0698-3457	6	1	RESISTOR 316K 1% .125W F TC=0+-100	28480	0698-3457
A3R18	0757-0446	3	1	RESISTOR 15K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1502-F
A3R19	0757-0416	7	2	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A3R20	0757-0280	3	4	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A3R21	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A3R22	0757-0438	3	3	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5111-F
A3R23	0698-3260	9	1	RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A3R24	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5111-F
A3R25	0757-0442	9	3	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A3R26	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A3R27	0699-0069	2		RESISTOR 2.15M 1% .125W F TC=0+-100	28480	0699-0069
A3R28	0757-0443	0	1	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1102-F
A3R29	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A3R30	0757-0472	5	1	RESISTOR 200K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2003-F
A3R31	0698-3454	3	2	RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2153-F
A3R32	0699-0069	2		RESISTOR 2.15M 1% .125W F TC=0+-100	28480	0699-0069
A3R33	0698-3454	3		RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2153-F
A3R34 - R35				NOT ASSIGNED		
A3R36	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1002-F
A3R37	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A3R38	0698-0083	8	2	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
A3R39	0757-0351	9	1	RESISTOR 402 1% .25W F TC=0+-100	24546	C5-1/4-TO-402R-F
A3R40	0698-3446	3	1	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-TO-383R-F
A3R41	0698-0085	0	1	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2611-F
A3R42				NOT ASSIGNED		
A3R43	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1961-F
A3R44	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-TO-5111-F
A3R45	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A3R46	0698-3155	1	1	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-TO-4641-F
A3R47				NOT ASSIGNED		
A3R48	1810-0374	1	1	NETWORK RESISTOR 8-SIP 1K OHM X 4	01121	208B102
A3R49	0699-0071	6	2	RESISTOR 4.64M 1% .125W F TC=0+-100	28480	0699-0071
A3R50	0699-0069	2		RESISTOR 2.15M 1% .125W F TC=0+-100	28480	0699-0069
A3R51	0699-0071	6		RESISTOR 4.64M 1% .125W F TC=0+-100	28480	0699-0071
A3R52	0757-0276	7	1	RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-TO-6192-F
A3R53	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-TO-511R-F
A3TP1 - TP20	1251-5177	6	20	CONNECTOR-SGL CONT PIN .031 IN-BSC-SZ	28480	1251-5177

See introduction to this section for ordering information.
*Indicates factory-selected value.

Table 6-4. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3U1	1820-1416	5	1	IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A3U2	1820-1203	8	1	IC GATE TTL LS AND TPL 3-INP	01295	SN74LS11N
A3U3	1820-1112	8	1	IC FF TTL LS D-TYPE POS EDGE TRIG	01295	SN74LS74AN
A3U4	1820-2078	7	1	IC CNTR TTL LS DECD DUAL 4-BIT	01295	SN74LS490N
A3U5	1820-1201	6	1	IC GATE TTL LS AND QUAD 2-INP	01295	SN74LS08N
A3U6	1820-2096	9	1	IC CNTR TTL LS BIN DUAL 4-BIT	01295	SN74LS393N
A3U7	1826-0122	0	1	IC 7805 V RGLTR TO-220	07263	7805UC
A3U8	1820-0939	5	1	IC FF CMOS D-TYPE POS-EDGE-TRIG DUAL	3L680	CD4013BE
A3U9				NOT ASSIGNED		
A3U10	1820-2466	7	1	IC TIMER CMOS	32293	ICM7555IPA
A3U11	1826-0600	3	1	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-PIN	04713	TL074ACN
A3U12	1820-1795	3	1	IC ANALOG SWITCH 4-SPST 16-DIP-P	27014	LF13331N
A3U13	1826-0493	8	1	IC OP AMP LOW-BIAS-H-IMPD 8-DIP P PKG	04713	MLM308AP1
A3U14	1826-0296	9	1	IC OP AMP GP 8-DIP P PKG	28480	1826-0296
A3U15	1826-0065	0	1	IC COMPARATOR PRCN 8-DIP P PKG	S0545	UPC311C
A3U16	1820-2668	1	2	IC DRVR TTL LINE DRVR DUAL 3-INP	01295	SN75114N
A3U17	1826-0775	9	1	IC LINEAR DA7Q	28480	1DA7Q
A3U18	1820-2668	1		IC DRVR TTL LINE DRVR DUAL 3-INP	01295	SN75114N
A3U19	1820-0471	0	1	IC INV TTL HEX 1-INP	01295	SN7406N
				MISCELLANEOUS A3 PARTS		
	1258-0141	8	7	JUMPER-REMOVABLE FOR 0.025-IN-SQ PINS	28480	1258-0141
	0340-0907	8	1	INSULATOR- TRANSISTOR- NYLON	28480	0340-0907
A4	**05518-60004**	**1**	**1**	**A4 SAMPLER BOARD (SERIES 2216)**	**28480**	**05518-60004**
A4CR1	1990-0770	1		PHOTODIODE ID=30NA-MAX	32694	OP 913 (SELECTED)
ARP1	1251-6778	5	1	CONNECTOR 4-PIN F POST TYPE	28480	1251-6778
				MISCELLANEOUS A4 PARTS		
	0340-0907	8	1	INSULATOR- TRANSISTOR- NYLON	28480	0340-0907
				FOR 5518A MISCELLANEOUS AND CHASSIS PARTS- SEE FIGURE 6-9.		

See introduction to this section for ordering information.
*Indicates factory-selected value.

Table 6-5. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	**10751-60001**	**2**	**1**	**A1 PC BOARD ASSEMBLY**	**28480**	**10761-60001**
A1C1	0160-4557	0	8	CAPACIT0R-FXD .1UF 50VDC CER	16299	CAC04X7R104M050A
A1C2	0160-4554	7	7	CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C3	0160-3072	2	6	CAPACIT0R-FXD 1UF +-10% 100VDC MET-POLYE	28480	0160-3072
A1C4	0160-4557	0		CAPACIT0R-FXD .1UF 50VDC CER	16299	CAC04X7R104M050A
A1C5	0160-3072	2		CAPACIT0R-FXD 1UF +-10% 100VDC MET-POLYE	28480	0160-3072
A1C6	0180-3573	0	2	CAPACITOR-FXD 10UF +-10% 35VDC TA	28480	0180-3573
A1C7	0180-3573	0		CAPACITOR-FXD 10UF +-10% 35VDC TA	28480	0180-3573
A1C8	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C9	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C10	0160-3072	2		CAPACIT0R-FXD 1UF +-10% 100VDC MET-POLYE	28480	0160-3072
A1C11	0160-3072	2		CAPACIT0R-FXD 1UF +-10% 100VDC MET-POLYE	28480	0160-3072
A1C12	0160-4554	7		CAPACIT0R-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C13	0160-4557	0		CAPACIT0R-FXD .1UF 50VDC CER	16299	CAC04X7R104M050A
A1C14	0160-4554	7		CAPACIT0R-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C15	0160-3072	2		CAPACIT0R-FXD 1UF +-10% 100VDC MET-POLYE	28480	0160-3072
A1C16	0160-3072	2		CAPACIT0R-FXD 1UF +-10% 100VDC MET-POLYE	28480	0160-3072
A1C17	0160-4557	0		CAPACIT0R-FXD .1UF 50VDC CER	16299	CAC04X7R104M050A
A1C18	0160-4809	5	1	CAPACITOR-FXD 390PF +-5% 100VDC CER	28480	0160-4809
A1C19	0160-4554	7		CAPACIT0R-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C20	0160-4557	0		CAPACIT0R-FXD .1UF 50VDC CER	16299	CAC04X7R104M050A
A1C21	0160-4557	0		CAPACIT0R-FXD .1UF 50VDC CER	16299	CAC04X7R104M050A
A1C22	0160-4557	0		CAPACIT0R-FXD .1UF 50VDC CER	16299	CAC04X7R104M050A
A1C23	0160-4554	7		CAPACITOR-FXD .01UF +-20% 50VDC CER	28480	0160-4554
A1C24	0160-4557	0		CAPACIT0R-FXD .1UF 50VDC CER	16299	CAC04X7R104M050A
A1CR1	1902-0032	3	1	DIODE-ZNR 5.49V 5% DO-35 PD=.4W	28480	1902-0032
A1CR2	1902-3070	5	1	DIODE-ZNR 4.22V 5% DO-35 PD=.4W	28480	1902-3070
A1CR3	1901-0050	3	3	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR5	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1J1	1251-4989	6	1	CONNECTOR 5-PIN M POST TYPE	28480	1251-4989
A1J2	1251-6778	5	1	CONNECTOR 4-PIN F POST TYPE	28480	1251-6778
A1J3	1251-6855	9	1	CONENCTOR 8-PIN M POST TYPE	28480	1251-6855
A1Q1, C2	1853-0281	9	2	TRANSITOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A1R1	2100-3876	0	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 17-TRN	28480	2100-3876
A1R2	0698-3158	4	1	RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2372-F
A1R3	0699-0811	2	1	RESISTOR 33K .1% .125W F TC=0+-5	28480	0699-0811
A1R4	0757-0418	9	2	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-TO-619R-F
A1R5	0698-3455	4	1	RESISTOR 261K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2613-F
A1R6	0757-0472	5	1	RESISTOR 200K 1% .125W F TC=0+-100	24546	C4-1/8-TO-2003-F
A1R7	1810-0504	9	2	NETWORK RESISTOR 16-IP MULTI-VALUE	28480	1810-0504
A1R8	2100-3875	9	1	RESISTOR-TRMR 2K 10% C TOP-ADJ 17-TRN	28480	2100-3875
A1R9	1810-0599	2	1	RESISTOR NETWORK 8P34 3 VAL 1WF	28480	1810-0599
A1R10	0757-0418	9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-TO-619R-F
A1R11	0698-8005	0	1	RESISTOR 75 .1% .1W F TC=0+-15	07716	MAR5-1/10-T10-75R0-B
A1R12	0699-0642	7	1	RESISTOR 10K .1% .1W F TC=0+-5	28480	0699-0642
A1R13	0757-0438	3	2	RESISTOR 5.11K 1% .125W F TC=0+-100	28480	0757-0438
A1R14	0698-7222		1	RESISTOR 261 1% .05W	28480	0698-7222
A1R15	1810-0598	1	1	RESISTIVE NETWORK 4P2R 3 VAL 1WF	28480	1810-0598
A1R16	1810-0504	9		NETWORK RESISTOR 16-DIP MULTI-VALUE	28480	1810-0504
A1R17	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A1R18	0757-0438	3	1	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8--TO-5111-F
A1R19	1810-0597	0	1	RESISTIVE NETWORK 4P2R 10K OHM 1WF	28480	1810-0597
A1R20	0698-0082	7	1	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-TO-4640-F
A1R21	0757-0407	6	1	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-TO-201-F
A1S1 - S17	1251-4682	6	17	CONNECTOR 3-PIN M POST-TYPE	28480	1251-4682
A1S18	3101-1782	6	1	SWITCH-TGL SUBMIN SPDT 2A 250VAC PC	28480	3101-1782
A1TP1 - TP5	0360-0124	3	5	CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124

Table 6-5. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1U1	1826-0543	9	4	IC OP AMP LOW-DRIFT TO-99 PKG	06665	OP-07CJ
A1U2	1826-0543	9		IC OP AMP LOW DRIFT TO-99-PKG	06665	OP-07CJ
A1U3	1826-0761		1	IC INSTRM AMP 14-PIN DIP-C	32293	ICL7605CJN
A1U4	1826-0543	9		IC OP AMP LOW-DRIFT TO-99 PKG	06665	OP-07CJ
A1U5	1826-0965	9	1	IC-AD 584KH	28480	1826-0965
A1U6	1826-0543	9		IC OP AMP LOW-DRIFT TO-99 PKG	06665	OP 07CJ
	1258-0141	8	17	JUMPER-REMOVABLE FOR 0.025IN SQ PINS	28480	1258-0141
A2	**10751-60002**	**3**	**1**	**A2 AIR TEMP TRANSDUCER ASSEMBLY**	**28480**	**10751-60002**
A2C1	0160-3879	7	2	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A2P2	1251-5394	9	1	CONNECTOR-4-PIN M POST TYPE	28480	1251-5394
	0380-1539	8	2	STANDOFF-NYLON 8L M 3.0	28480	0380-1539
	0515-0753	3	4	SCREW-MYLON M3 X 5	28480	0515-0753
	10751-20003	0	1	HEATSINK	28480	10751-20003
				FOR 10751 MISCELLANEOUS AND CHASSIS PARTS, SEE FIGURE 6-10.		

Table 6-7. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	**10757-60001**	**8**	**1**	**BOARD, MATERIAL TEMPERATURE SENSOR**	**28480**	**10757-60001**
A1C1	0160-4557	0	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C2	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C3	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C4	0160-3335	0	4	CAPACITOR-FXD 470 PF +-10% 100VDC CER	28480	0160-3335
A1C5	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C6	0160-3335	0		CAPACITOR-FXD 470 PF +-10% 100VDC CER	28480	0160-3335
A1C7	0160-3335	0		CAPACITOR-FXD 470 PF +-10% 100VDC CER	28480	0160-3335
A1C8	0160-4557	0		CAPACITOR-FXD .1UF +-20% 50VDC CER	16299	CAC04X7R104M050A
A1C9	0160-3335	0		CAPACITOR-FXD 470 PF +-10% 100VDC CER	28480	0160-3335
A1C10	0160-3829	7	1	CAPACITOR-FXD .47UF +-10% 50VDC	28480	0160-3829
A1JB1	1810-0520	9	1	NETWORK SHUNT 16-PIN DIP; 8-SECTIONS; 1	28480	1810-0520
A1R1	2100-3123	0	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	02111	43P501
A1R2	0698-3446	3	1	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-TO-383R-F
A1R3	0698-4409	0	1	RESISTOR 127 1% .125W F TC=0+-100	24546	C4-1/8-TO-127R-F
A1R4	0698-4388	4	1	RESISTOR 63.4 1% .125W F TC=0+-100	24546	C4-1/8-TO-63R4-F
A1R5	0757-0401	0	1	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-TO-101-F
A1R6	0757-0180	2	1	RESISTOR 31.6 1% .125W F TC=0+-100	28480	0757-0180
A1R7	0699-1117	3	1	RESISTOR 4.02 1% .125W F TC=0+-100	28480	0699-1117
A1R8	0698-4361	3	1	RESISTOR 15.8 1% .125W F TC=0+-100	03888	PME55-1/8-TO-15R8-F
A1R9	0757-0407	6	1	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8L-TO-201-F
A1R10	0699-0644	9	1	RESISTOR 7.87 1% .125W F TC=0+-100	28480	0699-0644
A1R11	0699-1115	1	1	RESISTOR 47.5K .1% .1W F TC=0+-5	28480	0699-1115
A1R12	0699-1116	2	1	RESISTOR 49.3K .1% .1W F TC=0+-5	28480	0699-1116
A1R13	0699-0118	2	1	RESISTOR 20K .1% .1W F TC=0+-5	28480	0699-0118
A1R14	0699-1112	8	1	RESISTOR 2K .1% .1W F TC=+-5	28480	0699-1112
A1R15	0699-1113	9	1	RESISTOR 2.98K .1% .1W F TC=0+-5	28480	0699-1113
A1R16	2100-3154	7	1	RESISTOR-TRMR 1K 10% C SIDE-ADJ 17-TRN	02111	43P102
A1R17	0699-1114	0	1	RESISTOR 7.96K .1% .1W F TC=0+-5	28480	0699-1114
A1R18	0698-8625	0	1	RESISTOR 1K .1% .1W F TC=0+-5	28480	0698-8625
A1R19	0699-1111	7	1	RESISTOR 258 .1% .1W F TC=0+-5	28480	0699-1111
A1S1	1251-4047	7	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-4047
A1TP1	0360-0124	3	2	CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
A1TP2	0360-0124	3		CONNECTOR-SGL CONT PIN .04-IN-BSC-SZ RND	28480	0360-0124
A1U1	1826-0650	9	1	IC-AD 584KH	28480	1826-0650
A1U2	1826-0635	0	3	IC OP AMP LOW-OFS 8-DIP-P PKG	06665	OP-07CP
A1U3	1826-0635	0		IC OP AMP LOW-OFS 8-DIP-P PKG	06665	OP-07CP
A1U4	1826-0635	0		IC OP AMP LOW-OFS 8-DIP-P PKG	06665	OP-07CP
				MISCELLANEOUS PARTS		
	1200-0607	0	1	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
	1258-0141	8	1	JUMPER-REMOVABLE FOR 0.025-IN SQ PINS	28480	1258-0141
				FOR 10757 MISCELLANEOUS AND CHASSIS PARTS, SEE FIGURE 6-11.		

Table 6-8. Manufacturer's Code List

Mfr No.	Manufacturer Name	Address		Zip Code
S0545	Nippon Electric Co.	Tokyo	JP	
00000	Any Satisfactory Supplier			
01121	Allen-Bradley Co.	Milwaukee	WI	53204
01295	Texas Instr Inc Semicond Cmpnt Div	Dallas	TX	75222
02111	Spectrol Electronics Corp	City of Ind	CA	91745
03888	K D I Pyrofilm Corp	Whippany	NJ	07981
04713	Motorola Semiconductor Products	Phoenix	AZ	85008
06665	Precision Monolithics	Santa Clara	CA	95050
07263	Fairchild Semiconductor Div	Phoenix	AZ	85008
07716	TRW Inc Burlington Div	Burlington	IA	52601
10630	Anillo Industries Incorporated	Orange	CA	92667
11236	CTS of Berne Inc	Berne	IN	46711
15818	Teledyne Simiconductor	Mountain View	CA	94043
16299	Corning Glass Wks Component Div	Raleigh	NC	27604
18324	Signetics Corporation	Synnyvale	CA	94086
19701	Mepco/Electra Corp	Mineral Wells	TX	76067
24546	Corning Glass Works (Bradford)	Bradford	PA	16701
27014	National Semiconductor Corp	Santa Clara	CA	95051
28480	Hewlett-Packard Co Corporate HQ	Palo Alto	CA	94304
3L585	RCA Corp Solid State Div	Somerville	NJ	08876
3L680	Beman Manufacturing Inc	Etters	PA	17319
32694	Optron Inc	Carrollton	TX	75006
32293	Intersil Inc	Cupertino	CA	95014
34335	Advanced Micro Devices Inc	Synnyvale	CA	94086
50088	Mostek Corp	Carrollton	TX	75006
56289	Sprague Electric Co	North Adams	MA	01247
75915	Littelfuse Inc	Des Plaines	IL	60016
84411	TRW Capacitor Div	Ogallala	NE	69153
91637	Dale Electronics Incorporated	Columbus	NE	68601
98291	Sealectro Corp	Mamaroneck	NY	10544

5508A CABINET REPLACEABLE PARTS

ITEM	QTY	DESCRIPTION	HP PART NO.
1	1	COVER, TOP (METRIC)	5062-3730
2	1	TRIM, TOP	5041-8803
3	4	SCREW, 6-32 x 0.468", POZI	0570-1171
4	4	RETAINER, RING, 0.141"	0510-0043
5	2	COVER, SIDE (METRIC)	5062-3761
6	2	STRUT (METRIC)	5021-5836
7	2	SCREW-MACH 6-32 x .25" PAN-HD POZI	5062-0007
8	1	BARB COMPRESSOR	05508-20201
9	1	BRACKET-PC BOARD SUPPORT	05508-00009
10	2	HINGE, PC BOARD SUPPORT	05508-60301
11	8	SCREW-MACH M4 0.7 x 6	0515-1331
12	1	COVER, BOTTOM (METRIC)	5062-3742
13	2	FOOT, NON-SKID	5041-8822
14	2	STAND, TILT	1460-1345
15	2	FOOT	5041-8801
16	2	SCREW-MACH 8-32 x 0.548" PAN-HD POZI	2510-0267
17	2	RETAINER, BAIL HANDLE	5040-7216
18	2	ADAPTER, BAIL HANDLE	5040-7215
19	1	BAIL HANDLE	5061-0037

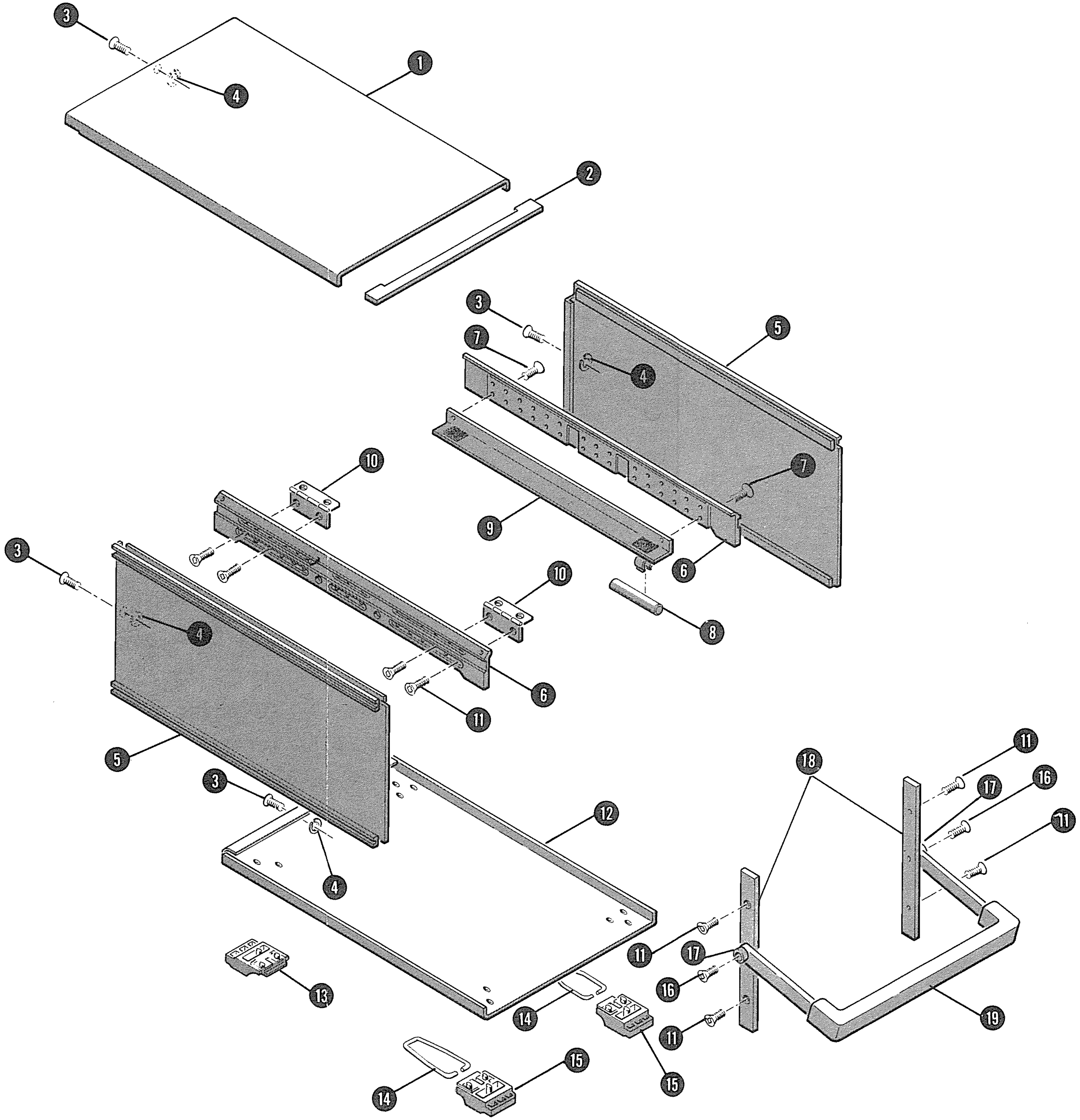


Figure 6-1. 5508A Cabinet Parts Exploded View

Figure 6-1
5508A CABINET PARTS EXPLODED VIEW

(See Page 6-23)

5508A RACK MOUNT REPLACEABLE PARTS

ITEM	QTY	DESCRIPTION	HP PART NO.
1	1	ADAPTER ASSEMBLY	5062-3907
2	1	RACK FLANGE	5021-8463
3	8	8-32 x 3/8 SCREW	2510-0193
	1	KIT, RACK, Option 908 (Not Shown)	5062-3960
	1	KIT, HANDLE (Not Shown)	5062-4003

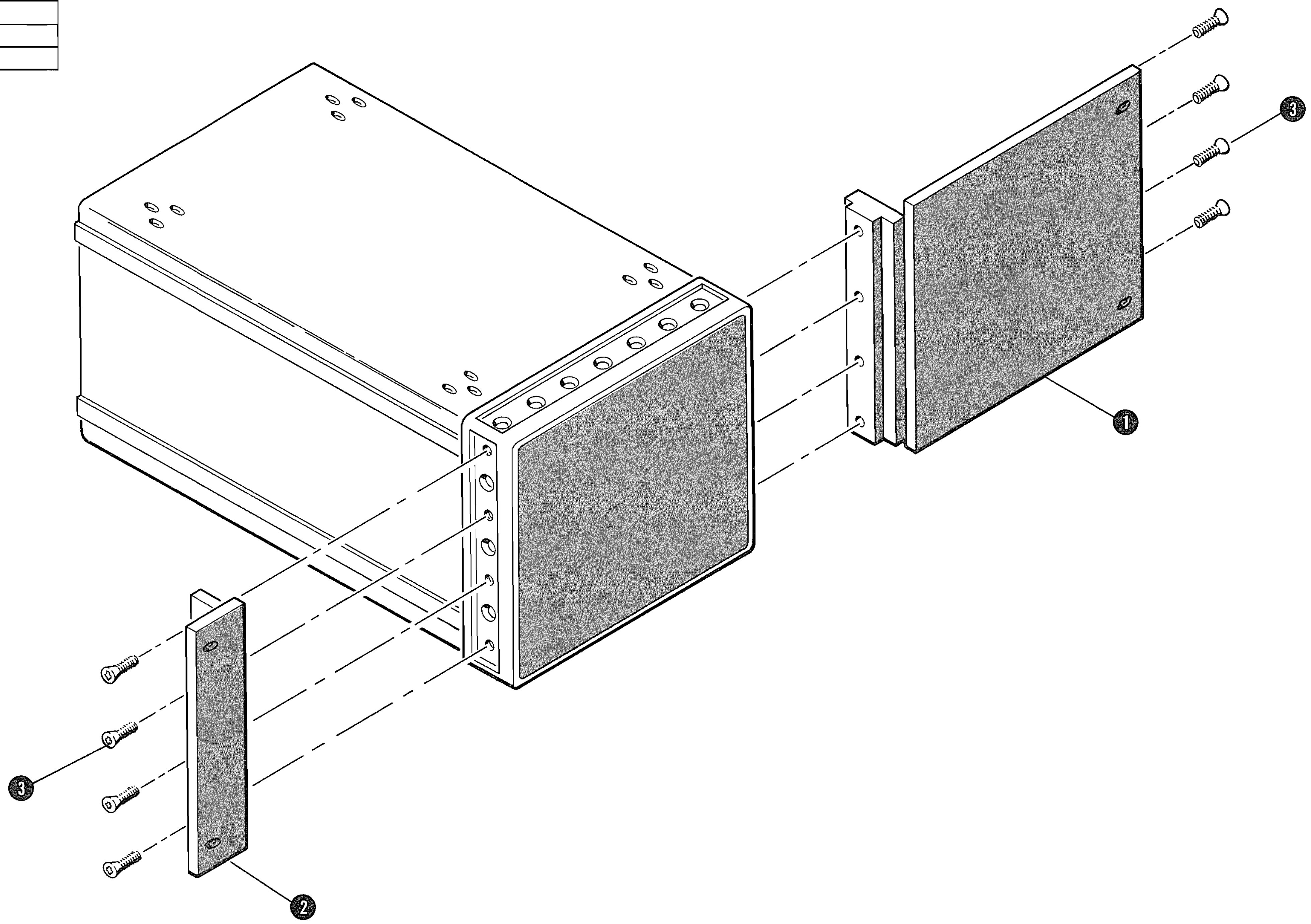


Figure 6-2. 5508A Rack Mount Kit

Figure 6-2
5508A RACK MOUNT KIT

(See Page 6-25)

5508A CHASSIS REPLACEABLE PARTS

ITEM	QTY	DESCRIPTION	HP PART NO.
1	1	COVER, HEAT SINK	05508-00008
2	1	BRACKET, LEFT	05508-00006
3	1	BRACKET, RIGHT	05508-00007
4	1	HEAT SINK	05508-20301
5	1	CHASSIS	05508-00003
6	1	BAR	05508-20303
7	1	BOARD ASSEMBLY, A5 POWER SUPPLY	05508-60005
8	1	TRANSFORMER, T1	05508-60206
9	2	STRUT	5021-5836
10	1	FAN ASSEMBLY, B1	05508-60208
11	3	GROMMET	0400-0082
12	4	SCREW, 10-32 × 3/8"	2680-0099
13	21	SCREW, 6-32 × 1/4"	2360-0113
14	4	SCREW, 4-40 × 5/16"	2200-0105
15	4	WASHER, LOCK	2190-0034
16	4	WASHER, #10	3050-0236
17	1	CABLE ASSEMBLY, REGULATOR	05508-60205
18	2	CLAMP	1400-0611
19		NOT ASSIGNED	
20	1	WASHER	3050-0105
21	1	CLAMP	1400-0017

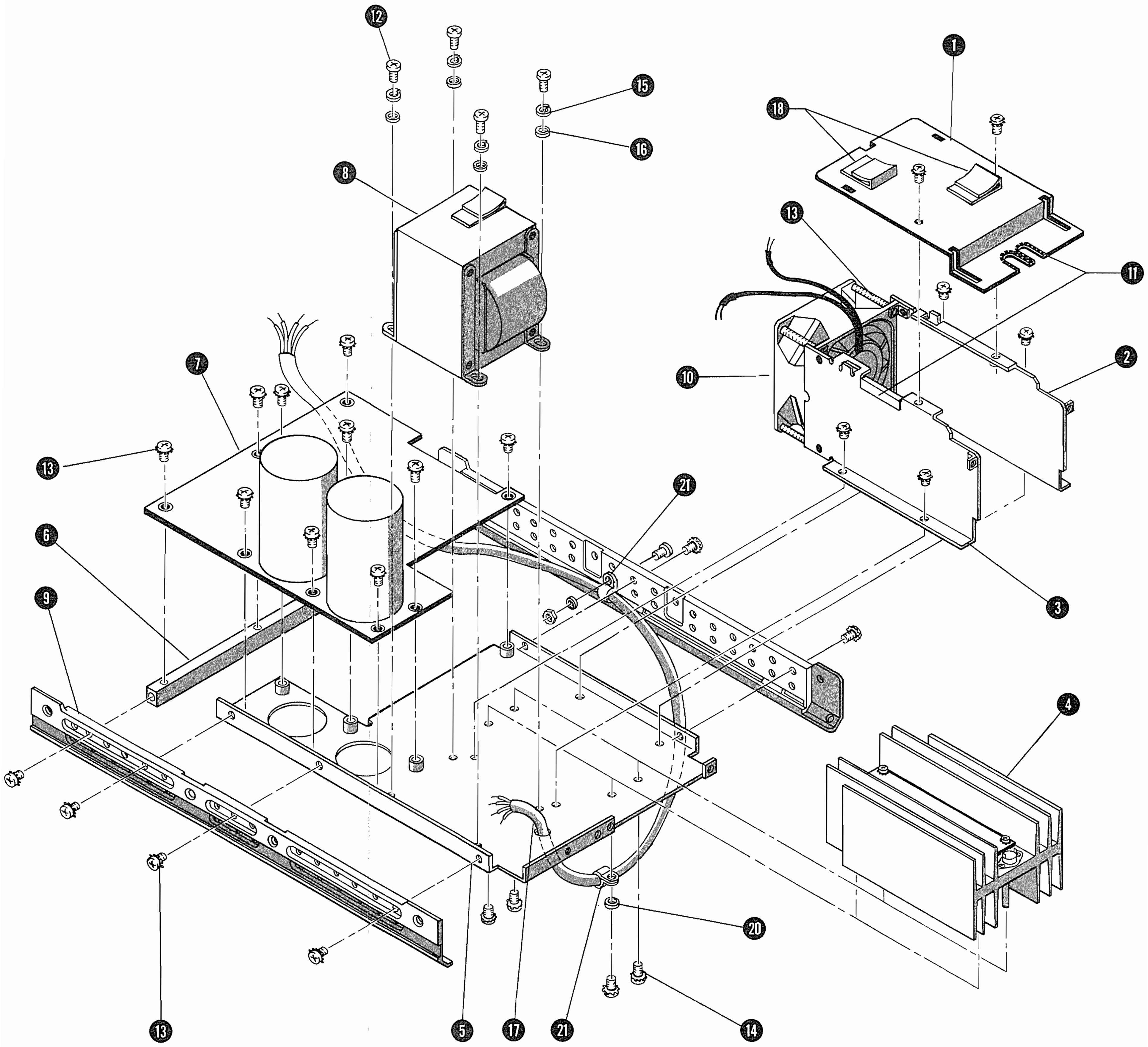

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Figure 6-3. 5508A Exploded Chassis View

Figure 6-3

5508A EXPLODED CHASSIS VIEW

(See Page 6-27)

5508A HEAT SINK REPLACEABLE PARTS

ITEM	QTY	DESCRIPTION	HP PART NO.
1	1	HEAT SINK	05508-20301
2	8	BUSHING, INSULATOR	1200-0147
3	1	BOARD, PC	05508-20006
4	1	CONNECTOR, 15-PIN	1251-6999
5	8	SCREW, 4-40 × 5/8”	2200-0113
6	4	STANDOFF	0380-1291
7	1	THERMAL SWITCH	3103-0099
8	4	SCREW, 4-40 × 1/4”	2200-0139
9	6	WASHER,LOCK	2190-0003
10	2	INSULATOR	0340-0596
11	2	TRANSISTOR (Q1, Q2)	1854-0669
12	4	NUT, 4-40	2260-0001
13	2	INSULATOR	0340-0864
14	2	DIODE (CR1, CR2)	1906-0261
15	1	INSULATOR	0340-0864
16	-	THERMAL COMPOUND	--

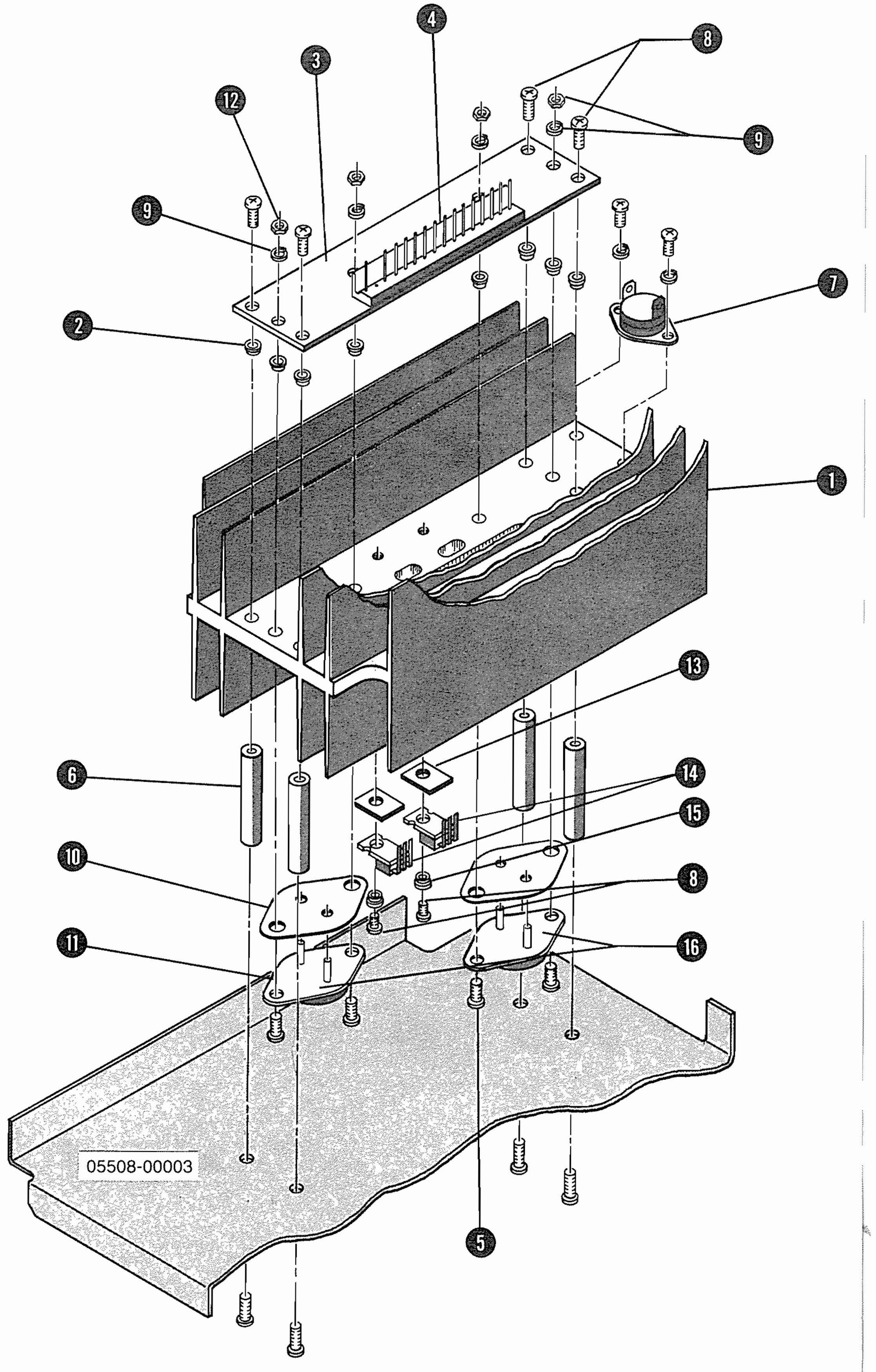


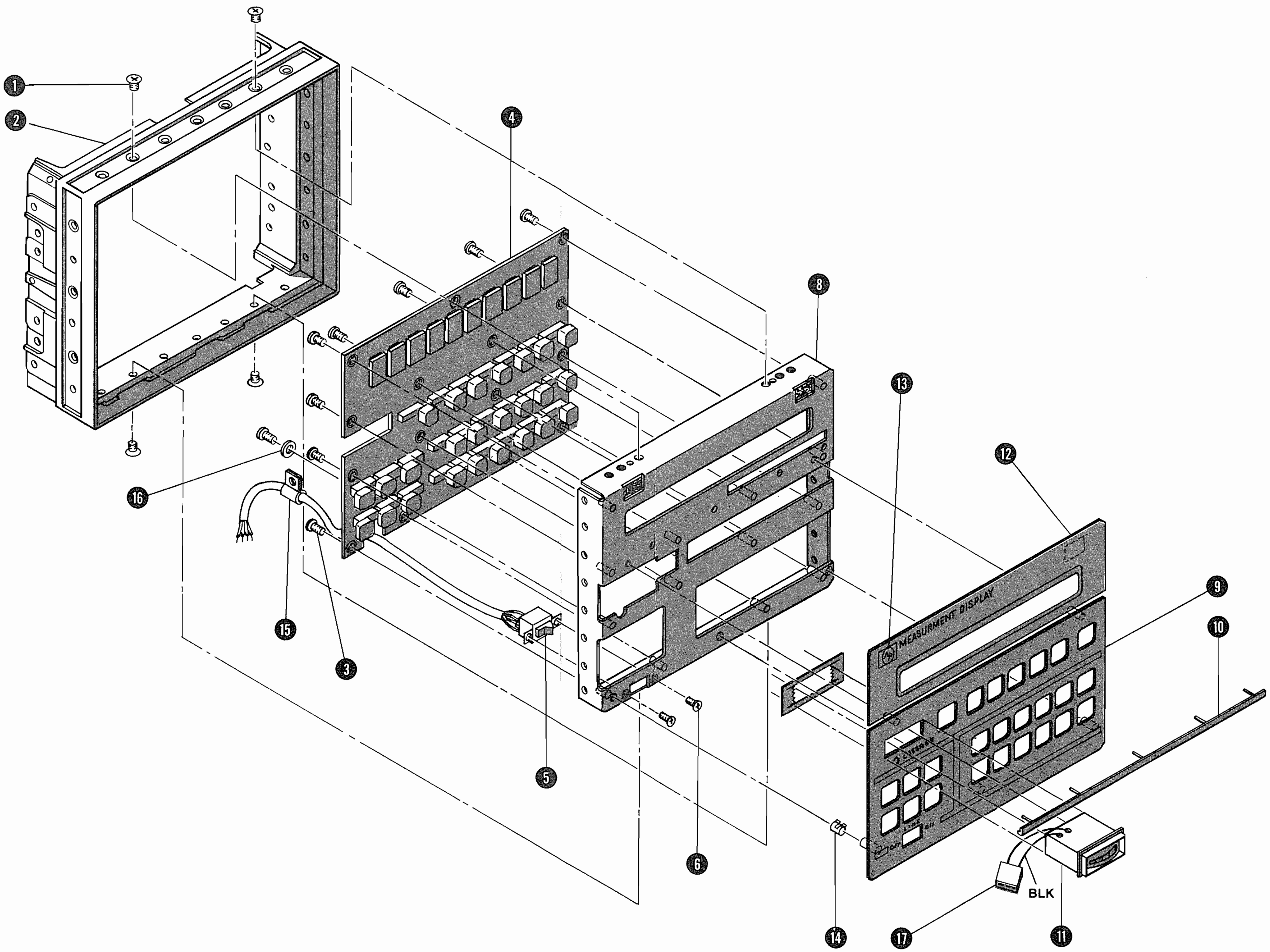
Figure 6-4. 5508A Heat Sink Exploded View

Figure 6-4
5508A HEAT SINK EXPLODED VIEW

(See Page 6-29)

5508A FRONT PANEL REPLACEABLE PARTS

ITEM	QTY	DESCRIPTION	HP PART NO.
1	4	SCREW, 6-32 x 1/4" FH 100°	2360-0333
2	1	FRAME (METRIC)	5021-8417
3		NOT ASSIGNED	
4	1	BOARD ASSY, A1 KEYBOARD DISPLAY	05508-60001
5	1	CABLE ASSY, POWER AC (Includes Rocker Switch) Cap is 5040-7946	05508-60204
6	2	SCREW, 4-40 x 1/4" FH 100°	2200-0542
7	2	FASTENER	05508-20305
8	1	PANEL, SUB	05508-00002
9	1	PANEL, FRONT	05508-00001
10	1	DIVIDER	5040-6927
11	1	METER, M1	1120-1586
12	1	DISPLAY	05508-20302
13	1	LOGO	7124-0891
14	5	CLAMP	0510-1148
15	1	CLAMP, CABLE	1400-0017
16	1	WASHER, FLAT	3050-0367
17	1	CABLE ASSEMBLY, METER	05508-60209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MEASURMENT DISPLAY
LINE
ON
OFF
BLK

Figure 6-5. 5508A Front Panel Exploded View

Figure 6-5
5508A FRONT PANEL EXPLODED VIEW

(See Page 6-31)

5508A REAR PANEL REPLACEABLE PARTS

ITEM	QTY	DESCRIPTION	HP PART NO.
1	1	CABLE ASSY, HP-IB	05508-60202
2	2	FASTENER	1530-1098
3	1	PLENUM	05508-00011
4	2	LOCKWASHER	2190-0577
5	1	POWER MODULE	0960-0443
6	1	NUT, 1/4" × 40 HEX	2950-0052
7	1	BOARD ASSY, A4 CONNECTOR	05508-60004
8	2	SCREW, 4-40 × 5/16"	2200-0105
9	12	SCREW, 4-40 × 5/16"	2200-0575
10	2	STANDOFF	0380-0644
11	1	PANEL, REAR	05508-00004
12	1	FOAM, FILTER	4208-0348
13	1	FRAME, FILTER	05508-00013
14	1	COVER, REAR	05508-00005
15	1	SCREW, 6-32 × 5/16" FH	2360-0334
16	28	SCREW, 6-32 × 1/4" PH	2360-0115
17	1	WIRE, G/Y	8150-2167
18	2	SCREW, 4-40× 1/4" FH	2200-0542
19	1	FRAME, REAR (METRIC)	5062-5818
20	4	SCREW, 6-32 × 3/16"	2360-0330
21	1	LABEL	7121-0927
22	4	POWER CORD WRAP	5041-8813
23	4	SCREW-MACH 3.5 × .6 × 25	0515-1233
24	1	FUSE, FAST-BLO FOR 100-120V LINES, 2 AMP, 250V	2110-0002
24A	1	FUSE, FAST-BLO FOR 198-240V LINES, 1AMP, 250V	2110-0001
25	1	PC BOARD LINE SELECTOR	ORDER BY DESCRIPTION

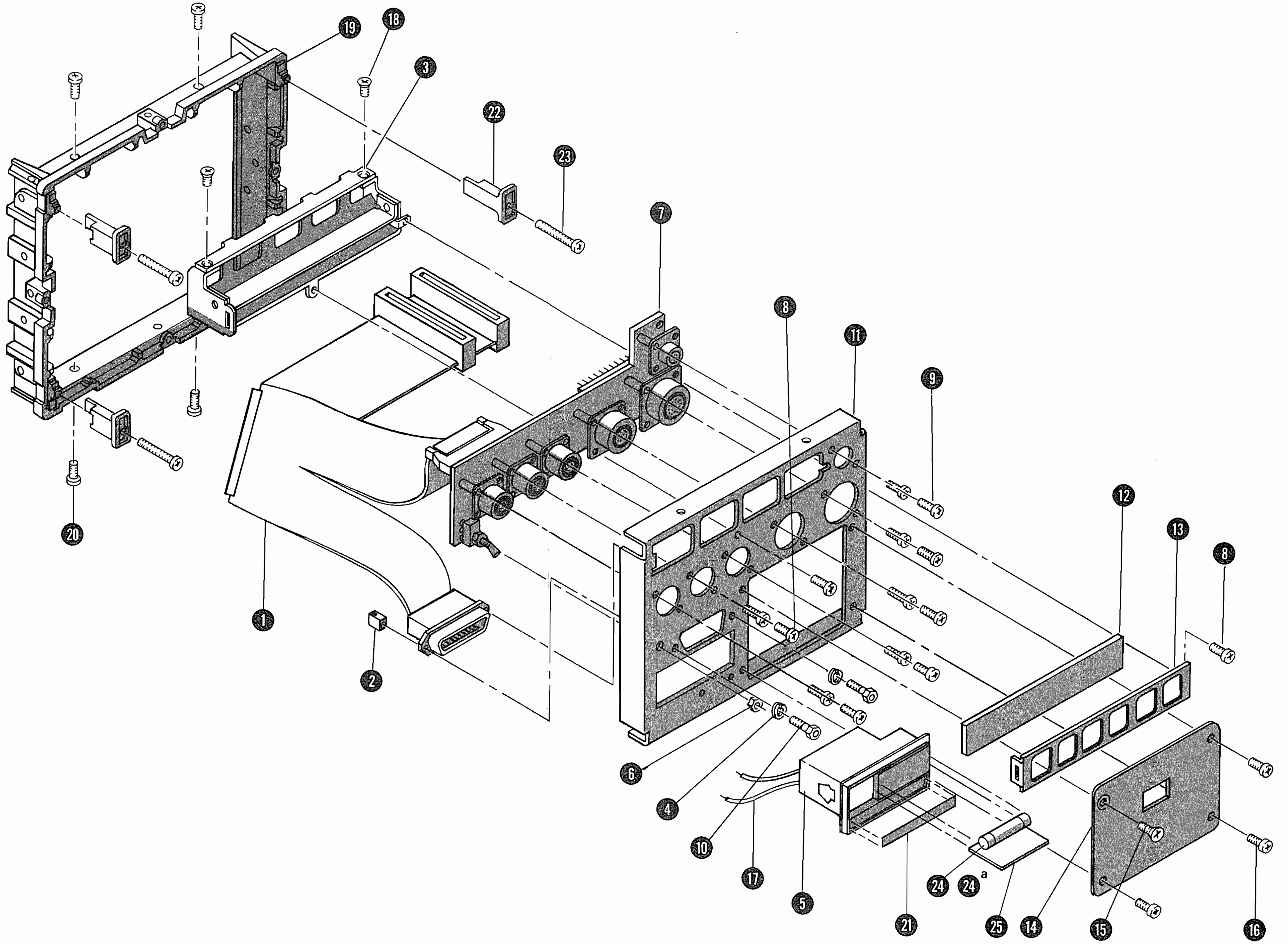
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Figure 6-6. 5508A Rear Panel Exploded View

Figure 6-6
5508A REAR PANEL EXPLODED VIEW

(See Page 6-33)

5508A CABLE ASSEMBLY REPLACEABLE PARTS

ITEM	QTY	DESCRIPTION	HP PART NO.
1	1	CABLE ASSEMBLY, LASER, W3	05508-60203
2	1	CABLE ASSEMBLY, REGULATOR, W5	05508-60205
3	1	PART OF TRANSFORMER, W6	05508-60206
4	1	CABLE ASSEMBLY, CONTROL, W1	05508-60201
5	1	CABLE ASSEMBLY, HP-IB ANALOG, A5	05508-60202
6	1	BOARD ASSEMBLY, POWER SUPPLY, A5	05508-60005
7	1	BOARD ASSEMBLY, PROCESSOR, A2	05508-60002
8	1	BOARD ASSEMBLY, COUNTER, A3	05508-60003
9	1	BOARD ASSEMBLY, CONNECTOR, A4	05508-60004

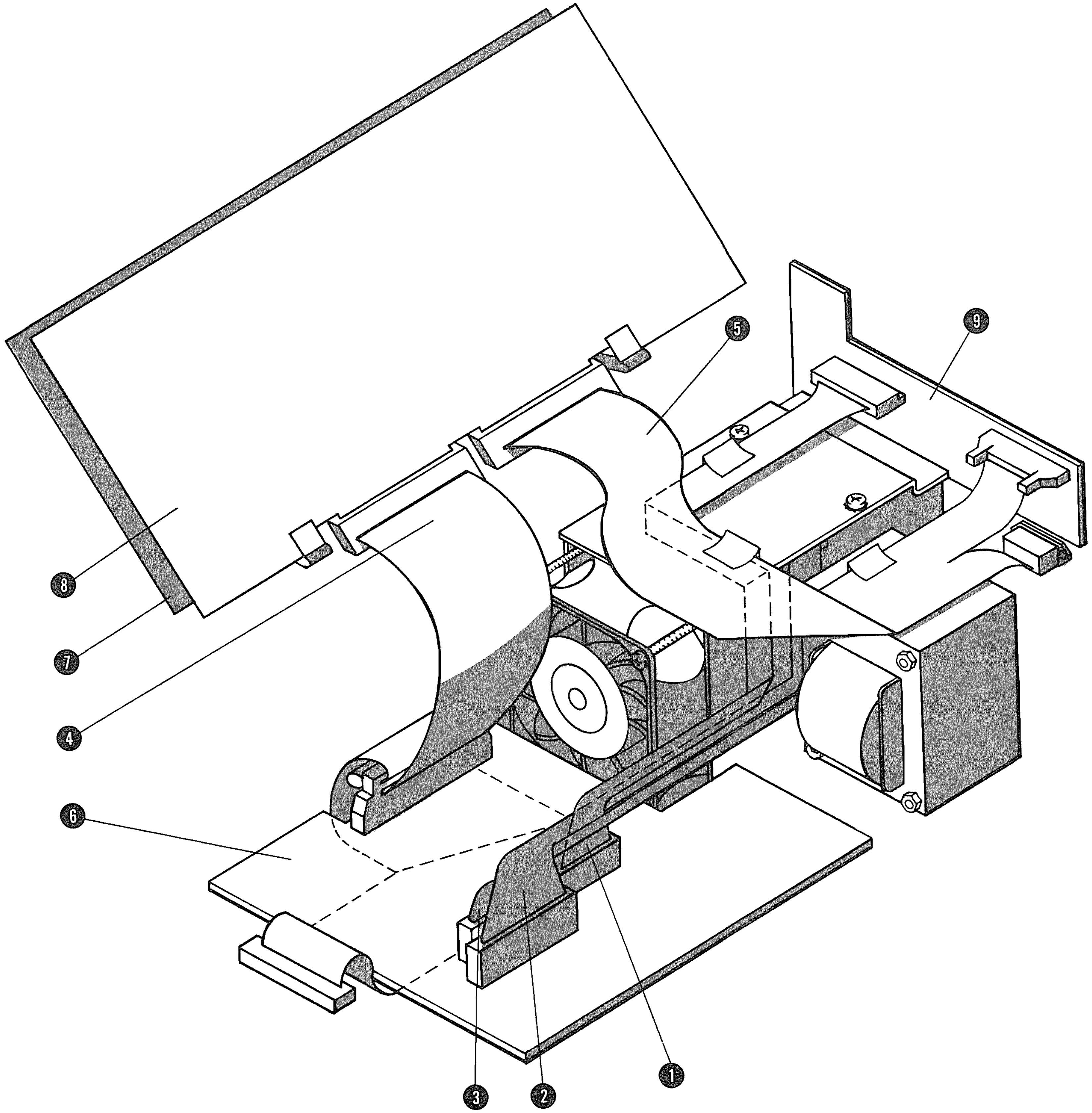


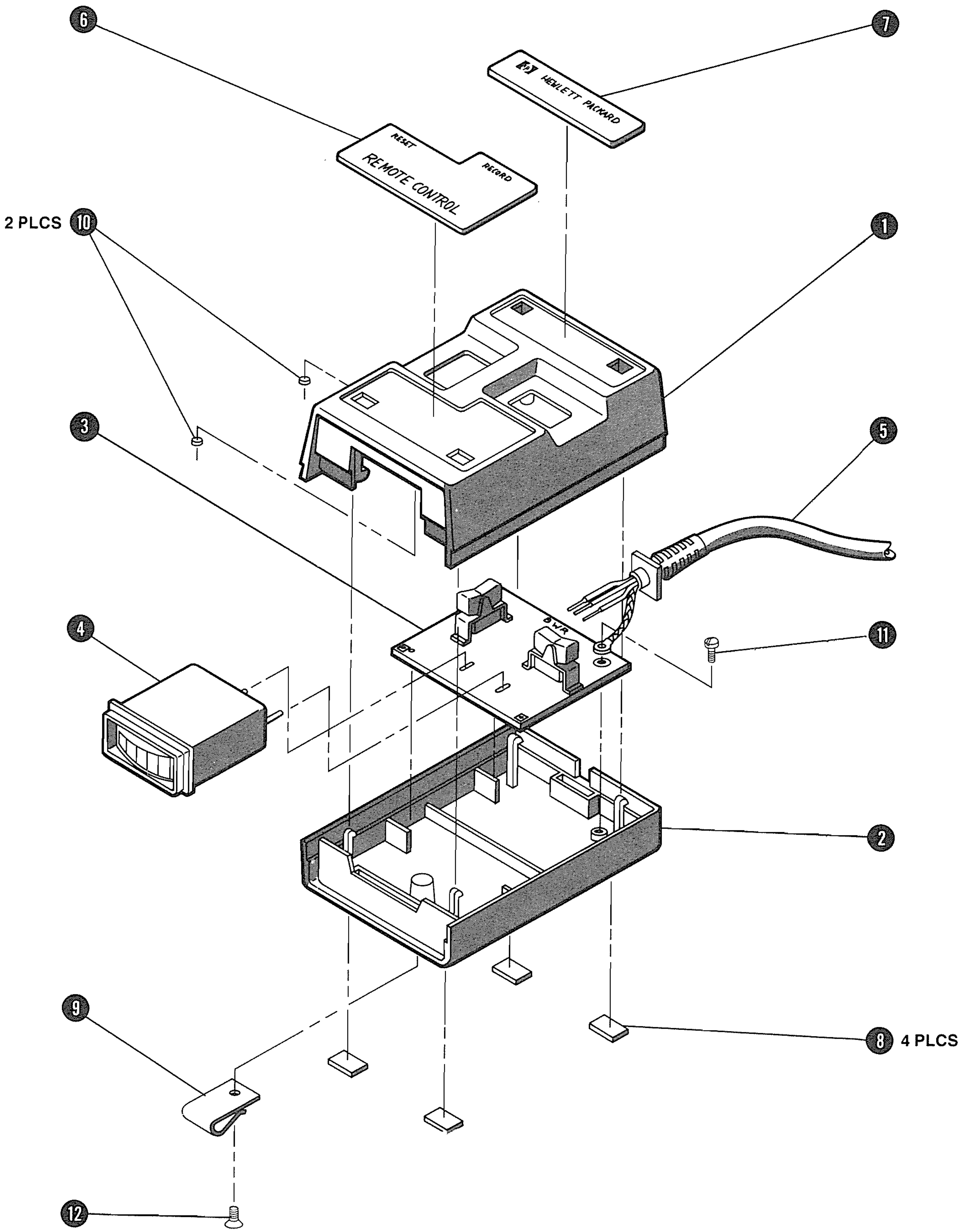
Figure 6-7. 5508A Cable Assembly Exploded View

Figure 6-7
5508A CABLE ASSEMBLY EXPLODED VIEW

(See Page 6-35)

REMOTE CONTROL REPLACEABLE PARTS

ITEM	QTY	DESCRIPTION	HP PART NO.
1	1	COVER	05508-40001
2	1	BASE	05508-40002
3	1	PC BOARD	05508-60020
4	1	METER	1120-1586
5	1	CABLE (4-pin circular Connector on Display end is 1251-3447; mates with 1251-3448)	8120-3490
6	1	LABEL, LOWER	7121-2659
7	1	LABEL, UPPER	7121-2658
8	4	RUBBER FOOT	0403-0267
9	1	CLIP	1600-1305
10	2	FOAM RUBBER PADS (0.5MM x 4.6MM)	05508-00015
11	1	SCREW, PAN HEAD M3 x 8	0515-0897
12	1	SCREW, FLAT HEAD M3 x .5 FMS x 6	0515-0219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7
HEWLETT PACKARD
RESET
RECORD
REMOTE CONTROL
2 PLCS 10
1
3
5
PWR
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2
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8 4 PLCS
12

Figure 6-8. Remote Control Unit Exploded View

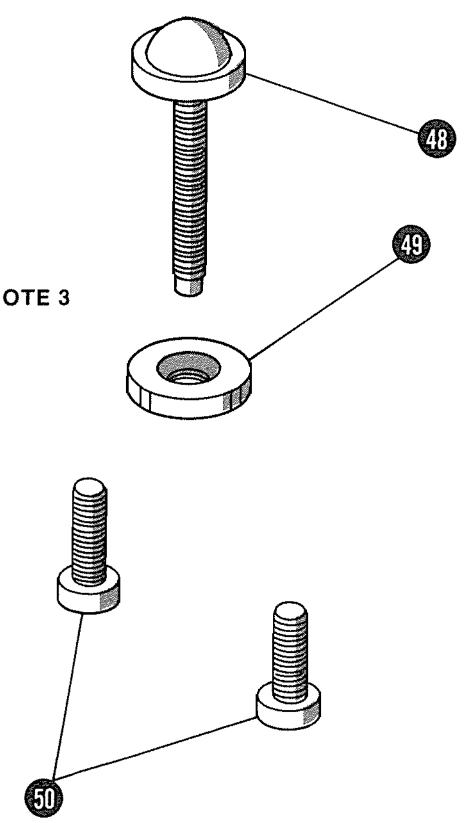
Figure 6-8
REMOTE CONTROL UNIT EXPLODED VIEW

(See Page 6-37)

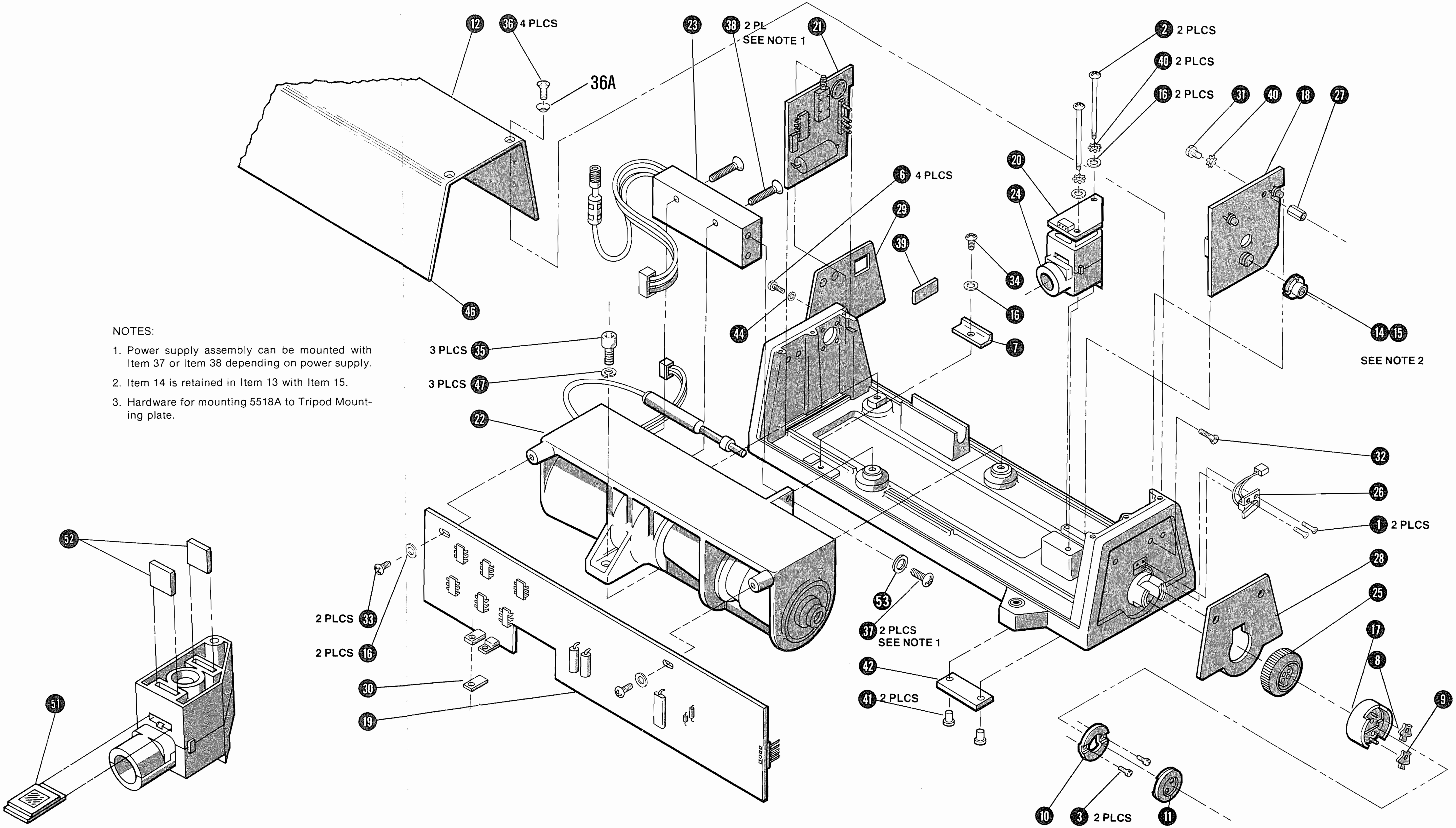
5518A LASER HEAD REPLACEBLE PARTS

ITEM	QTY	DESCRIPTION	HP PART NO.
1	2	SCREW, FLAT HEAD M3 × .5 FHMS × 6	0515-0223
2	2	SCREW, FLAT HEAD MX × 5 PHMS × 40	0515-0252
3	1	SCREW, M2.5 × .45 PHMS	0515-0736
4	2	VINYL BAG (NOT SHOWN)	9220-0158
5	1	FILTER (NOT SHOWN)	1000-0598
6	2	SCREW, M2.5 × .45 × 12 LG PHMS	0515-1351
7	1	MOUNTING CLIP, TRANSISTOR	05518-00002
8	1	SHUTTER, BEAM	05518-00004
9	1	SHUTTER, RETURN BEAM	05518-00005
10	1	SPRING, TURRET	05518-00006
11	1	FACE, TURRET	05518-00007
12	1	COVER	05518-00012
13	1	BASE, MACHINED	05518-20321
14	1	DEMOD POLARIZER ASSEMBLY	05518-60312
15	A/4	EPOXY (FOR ITEM 14)	8500-0044
16	7	WASHER, FLAT	3050-0891
17	1	BASE, TURRET	05518-40005
18	1	BOARD ASSEMBLY, RECEIVER	05518-60002
19	1	BOARD ASSEMBLY, CONTROL/REFERENCE	05518-60003
20	1	BOARD ASSEMBLY, SAMPLER	05518-60004
21	1	BOARD ASSEMBLY, CONNECTOR	05518-60001
22	1	LASER ASSEMBLY	05517-60801*
23	1	POWER SUPPLY ASSEMBLY	0950-0470
24	1	SAMPLER ASSEMBLY	05518-60307
25	1	STRAIGHTNESS MOUNT	05518-60308
26	1	CABLE SWITCH ASSEMBLY	05518-60309
27	1	STANDOFF, HEX M3 × .5 × 12	0380-1362
28	1	LABEL, FRONT	7121-1570
29	1	LABEL, REAR	7121-1571
30	1	INSULATOR, TRANSISTOR	0340-0864
31	1	SCREW M3 × .5 × 6 PHMS	0515-0055
32	1	SCREW M3 × .5 × 12 FHMS	0515-0077
33	2	SCREW M3 × .5 × 6.0 PHMS	0515-0211
34	1	SCREW M3 × .5 × 10.0 PHMS	0515-0407
35	3	SCREW M6 × 1.0 × 12 SOC HD	0515-0331
36	4	SCREW MACH 3 × .5 × 10MM LG	0515-1125
36A	4	WASHER, BEVELED	3050-1390
37	2	SCREW, M4 × .7 × 10 LG PHMS	0515-0414
38	2	SCREW M3 × .5 × 35 FHMS	0515-0990
39	1	LABEL, MANUFACTURE DATE	7121-1650
40	3	WASHER, STAR	2190-0644
41	1	RIVET, TUBULAR	3050-0062
42		NOT ASSIGNED	
43	-	NOT ASSIGNED	-
44	4	WASHER, FLAT	3050-0795
45	1	POLARIZER (NOT SHOWN)	1000-0616
46	-	NOT ASSIGNED	-
47	3	LOCKWASHER, SPLIT RING	2190-0592
48	1	LEVELING FOOT	05518-20316
49	1	LOCK NUT	05518-20317
50	3	CAP SCREWS M8 × 1.25	0515-0798
51	1	LIQUID CRYSTAL	1990-0768
52	2	ELASTOMERIC CONNECTOR	8160-0530
53	1	WASHER, FLAT	3050-0893

*item 22 Laser Tube Assembly is available as an exchange replacement part — P/N 05517-60501.



SEE NOTE 3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38 2 PL SEE NOTE 1
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2 2 PLCS
40 2 PLCS
16 2 PLCS
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NOTES:

1. Power supply assembly can be mounted with Item 37 or Item 38 depending on power supply.
2. Item 14 is retained in Item 13 with Item 15.
3. Hardware for mounting 5518A to Tripod Mounting plate.

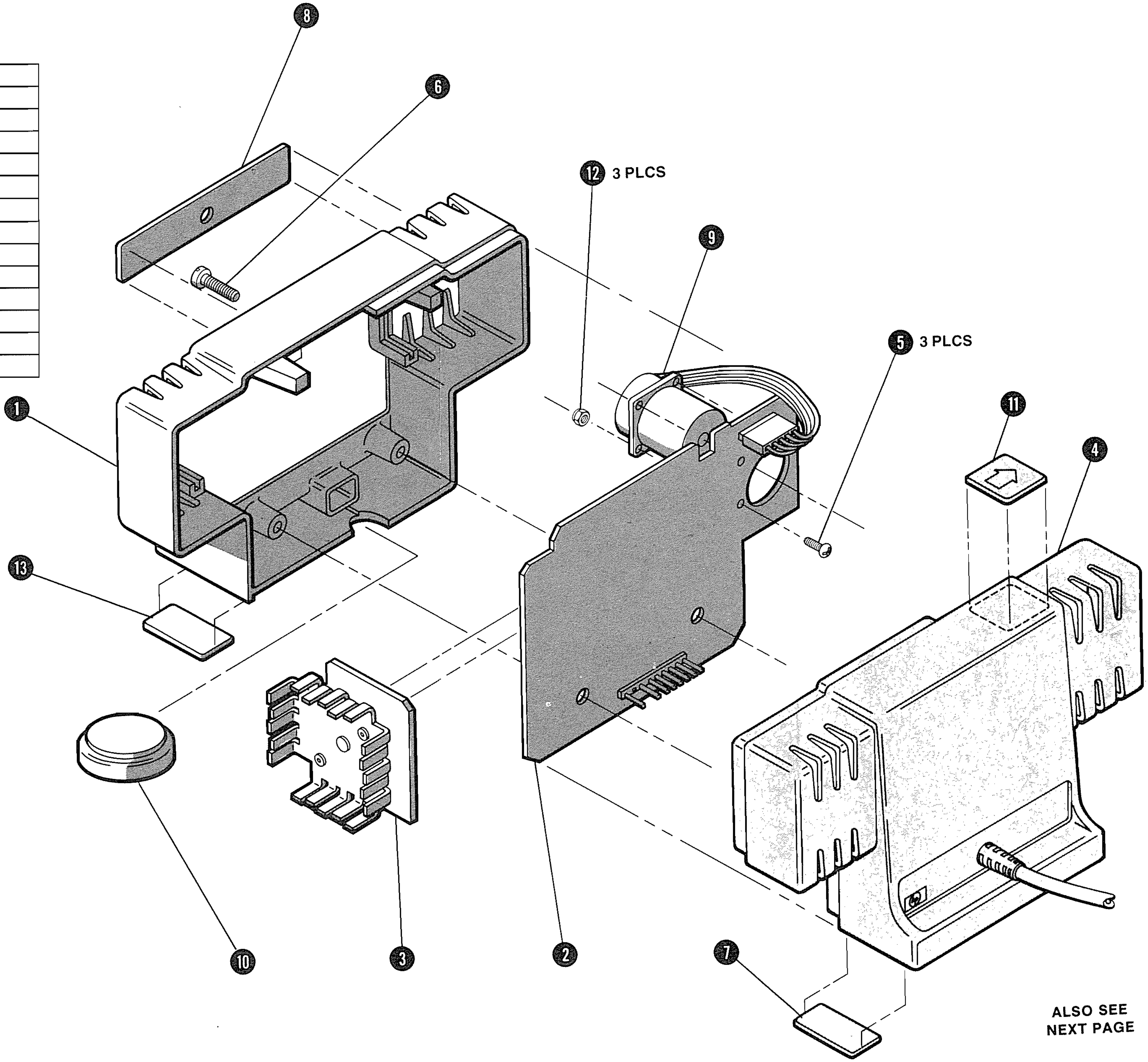
Figure 6-9. 5518A Laser Head Exploded View

10751A/B REPLACEABLE PARTS

ITEM	QTY	DESCRIPTION	HP PART NO.
1	1	HOUSING COVER	10751-40001
2	1	BOARD ASSEMBLY A1	10751-60001
3	1	BOARD ASSEMBLY, A2	10751-60002
4	1	CABLE AND HOUSING ASSEMBLY	(SEE TABLE 1)
5	3	SCREW 2x .45 x 8 PHMS	0515-0403
6	2	SCREW, M4 x .7 x .25	0515-0398
7	1	PLATE, SERIAL	5080-0098
8	1	LABEL, FRONT	10751-80002
9	1	PRESSURE TRANSDUCER ASSEMBLY	0960-0656
10	1	MAGNETIC BASE ASSEMBLY	9164-0184
11	1	LABEL, ORIENTATION	10751-80001
12	3	NUT, HEX M2.5	0535-0008
13	1	LABEL, CALIBRATION	7121-2719

TABLE 1

MODEL NUMBER	CABLE AND HOUSING ASSEMBLY	CABLE LENGTH
10751A	10751-60201	4M (16.4 ft.)
10751B	10751-60202	15M (49.2 ft.)

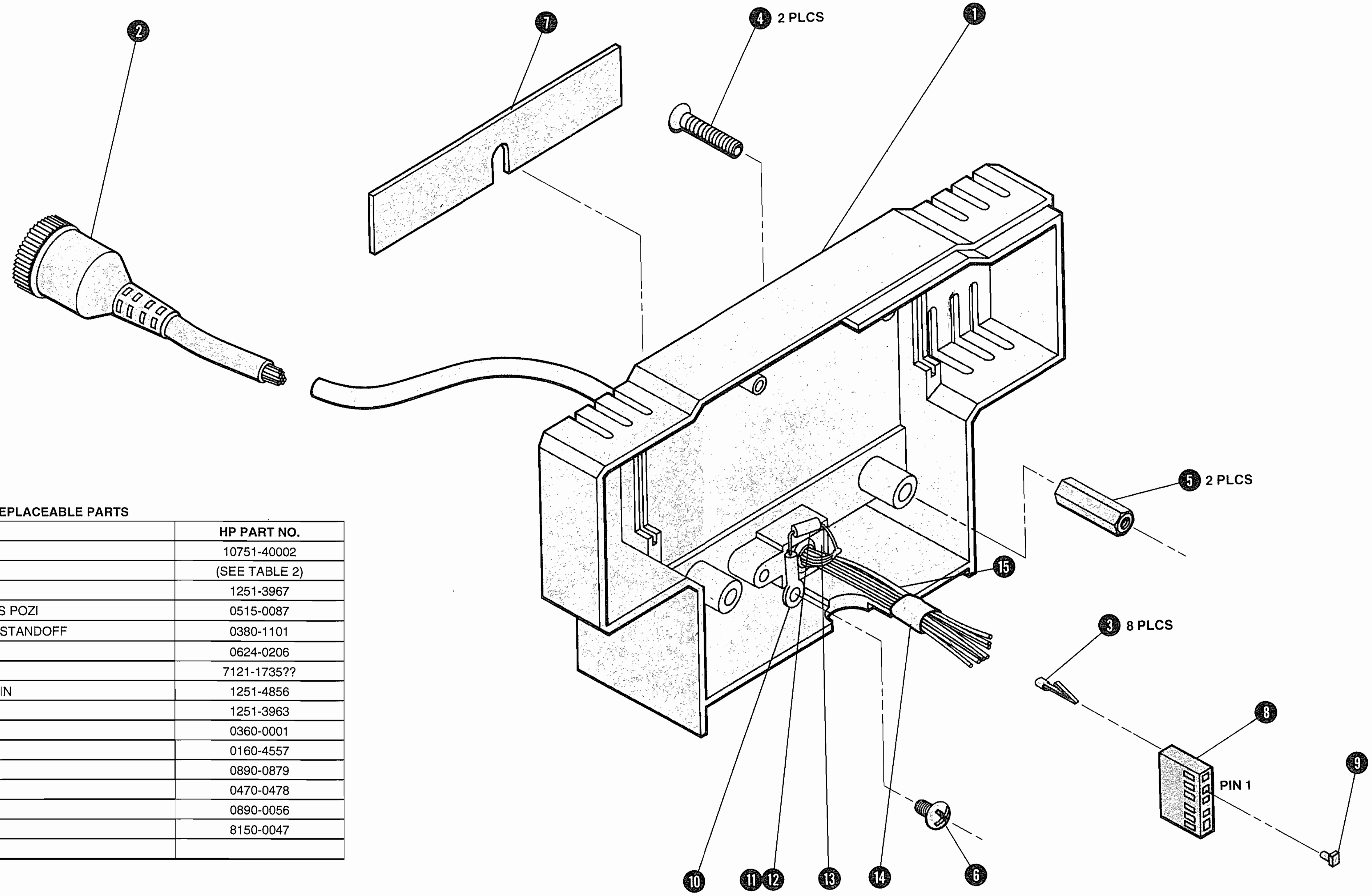


ALSO SEE NEXT PAGE

Figure 6-10. 10751A/B Exploded Views (Sheet 1 of 2)

Figure 6-1
10751A/B EXPLODED VIEWS (Sheet 1 of 2

(See Page 6-41



REMOTE CONTROL REPLACEABLE PARTS

ITEM	QTY	DESCRIPTION	HP PART NO.
1	1	HOUSING COVER	10751-40002
2	1	CABLE ASSEMBLY	(SEE TABLE 2)
3	1	CONTACT	1251-3967
4	1	SCREW M4 × .7 × 25 FHMS POZI	0515-0087
5	2	SCREW M4 × .7 × 16 HEX STANDOFF	0380-1101
6	1	#6 TAPTITE POZI PAN HD	0624-0206
7	1	LABEL REAR	7121-1735??
8	1	CONNECTOR BLOCK, 9 PIN	1251-4856
9	1	KEY	1251-3963
10	1	SOLDER LUG #6	0360-0001
11	1	CAPACITOR C1	0160-4557
12	A/R	SHRINK TUBING	0890-0879
13	A/R	EPOXY, 2-PART	0470-0478
14	A/4	SHRINK TUBING	0890-0056
15	2"	WIRE, 24-GAGE	8150-0047

TABLE 2

MODEL NUMBER	CABLE AND HOUSING ASSEMBLY	CABLE LENGTH
10751A	8120-3492	5 M (16.4 ft.)
10751B	8120-3663	15M (49.2 ft.)

Figure 6-10. 10751A/B Exploded Views (Sheet 2 of 2)

Figure 6-10
10751A/B EXPLODED VIEWS (Sheet 2 of 2)

(See Page 6-43)

10751A/B REPLACEABLE PARTS

ITEM	QTY	DESCRIPTION	HP PART NO.
1	1	LABEL, SENSOR	7121-1610
2	1	MATERIAL SENSOR CABLE	(SEE TABLE 1)
3	1	BOARD ASSEMBLY, MATERIAL TEMPERATURE	10757-60001
4	1	POD, MATERIAL SENSOR	10757-40001
5	1	LABEL, IDENTIFICATION	(SEE TABLE 1)
6	1	CABLE ASSEMBLY	10757-60304
7	1	LABEL, IDENTIFICATION	10757-80004
8	4	SCREW, M3 x .5 x 12	0515-0408
9	1	RETAINER, PUSH-ON	0510-1149
10	2	SHIELD, ESD	10757-20003
11	2	JUMPER, DIP SHUNT	1820-0520
12	1	JUMPER, REMOVABLE	1258-0141

TABLE 1

MODEL NUMBER	CABLE AND HOUSING ASSEMBLY	CABLE LENGTH
10757A	10757-60301	10757-80001
10757B	10757-60302	10757-80002
10757C	10757-60303	10757-80003

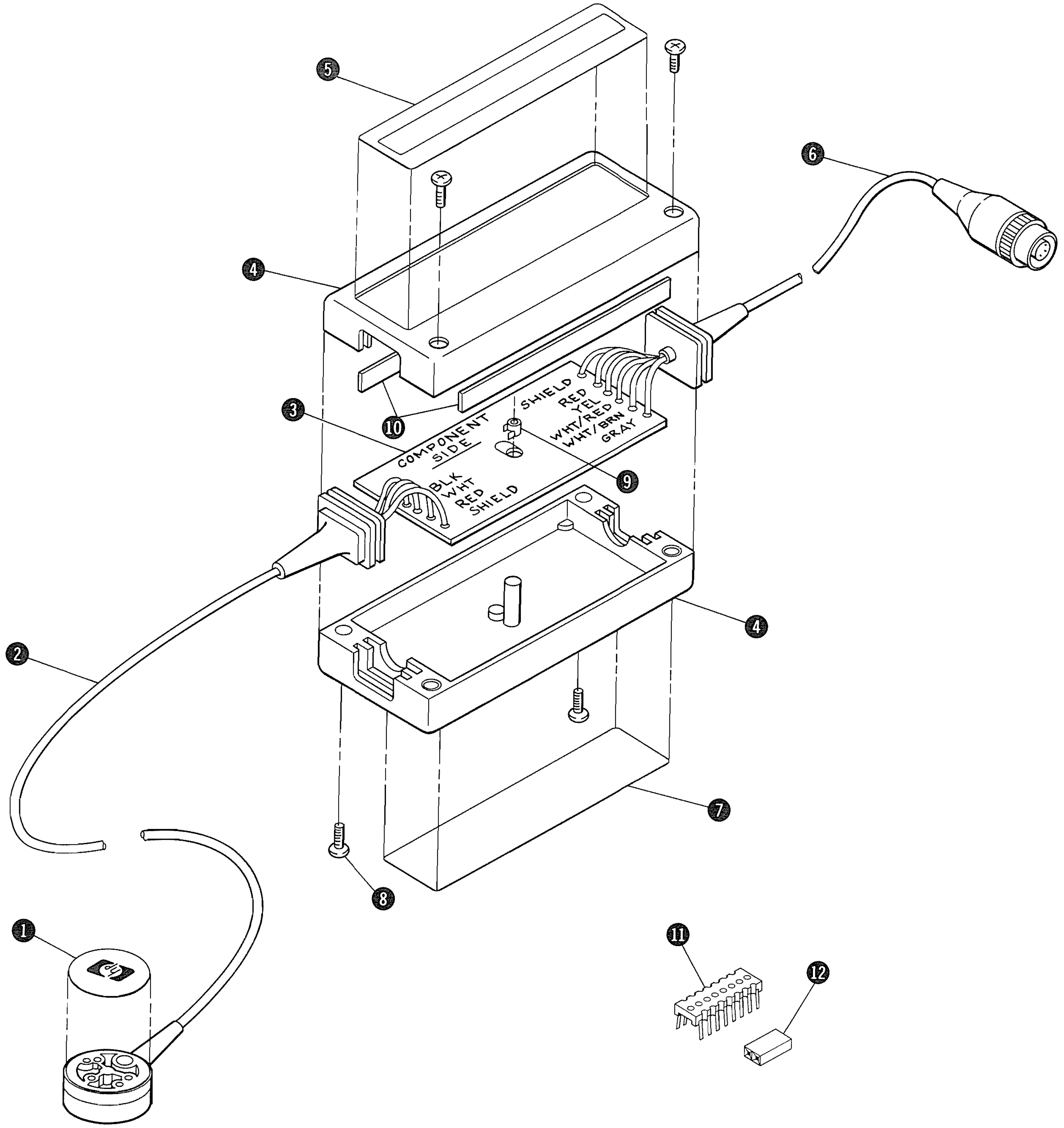
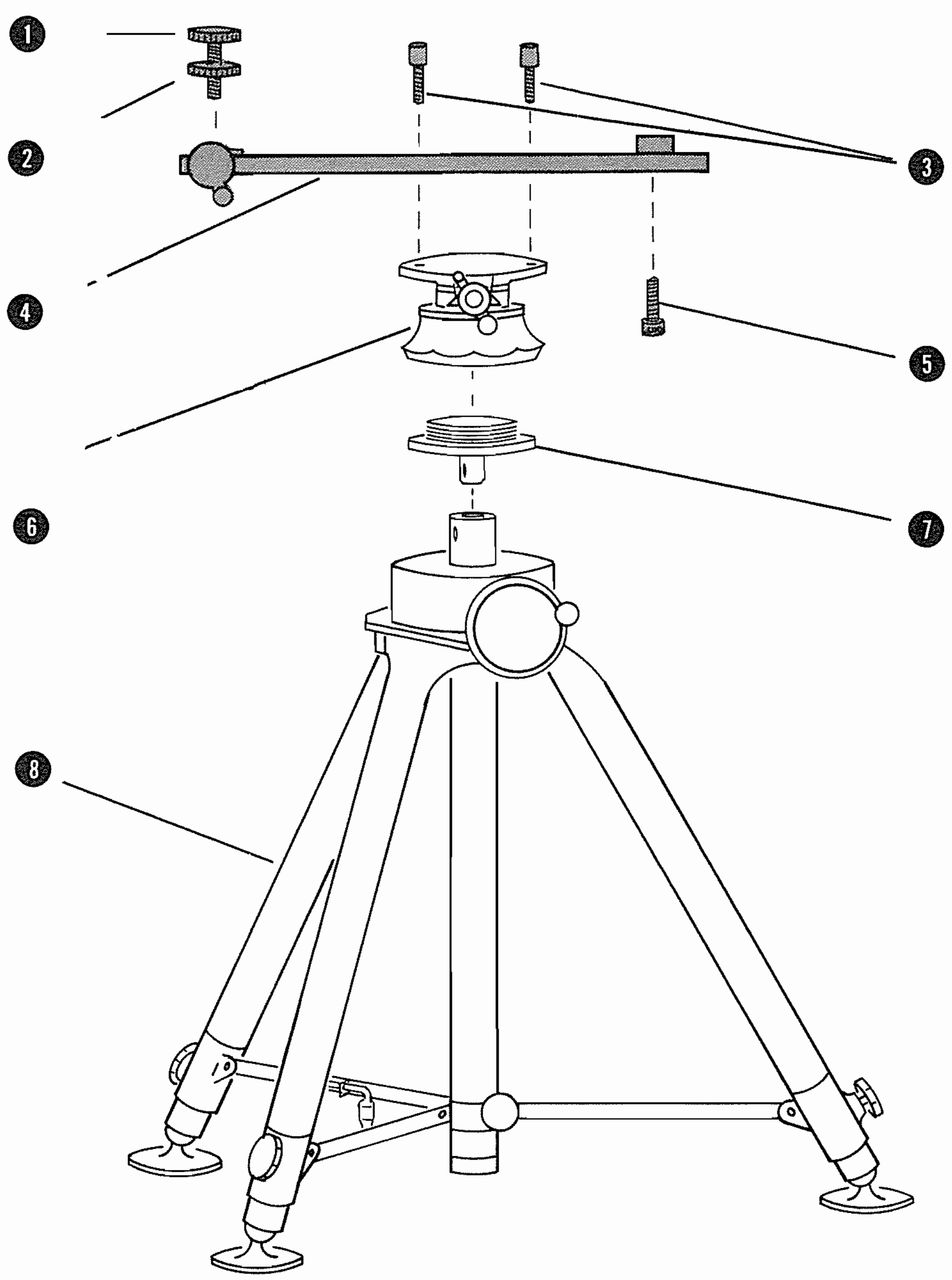

⑤
⑥
④
③
⑩
COMPONENT SIDE
SHIELD
RED
YEL
WHT/RED
WHT/BRN
GRAY
BLK
WHT
RED
SHIELD
⑨
④
②
⑦
⑧
①
⑪
⑫

Figure 6-11. 10757A/B/C Exploded Views

Figure 6-11
10757A/B/C EXPLODED VIEW

(See Page 6-45)



ITEM	QTY	DESCRIPTION	HP PART NUMBER
1	1	Leveling Foot	*05518-20316
2	1	Nut	*05518-20317
3	4	Cap Screws (1/4-20 X 3/4)	3020-0004
4	1	Mounting Plate	10753-60001
5	2	Cap Screws (M8 X 1.25)	*0515-0798
6	1	Cross Slide Assembler	1000-0387
7	1	Transit Adapter	1531-0052
8	1	Tripod	1530-2169

**Supplied with 5518A*

Figure 6-12. 10753A Tripod, HP Replaceable Parts

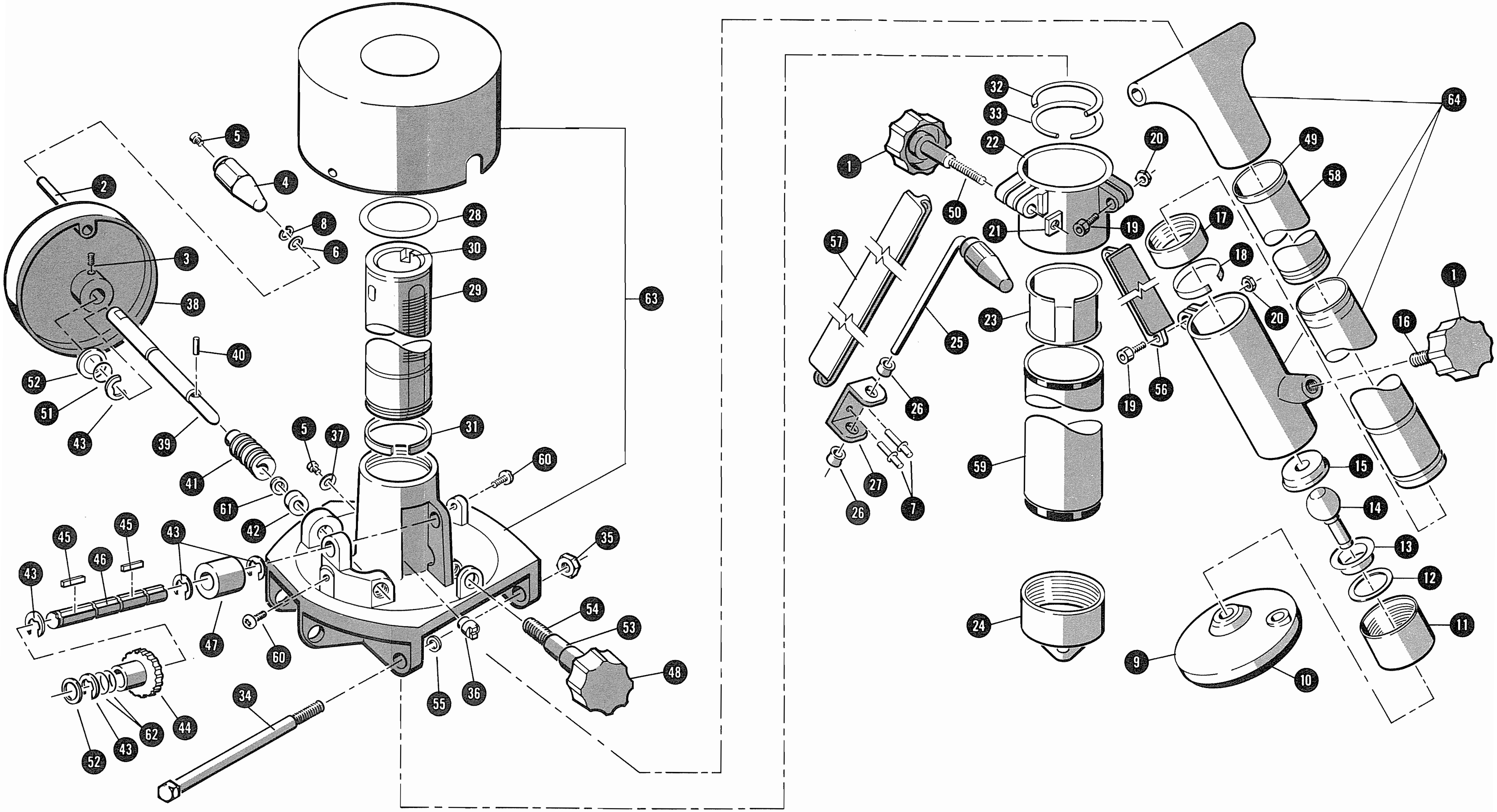
10753A TRIPOD MANUFACTURER'S REPLACEABLE PARTS

ITEM	DESCRIPTION	PART NUMBER
1	KNOB	1-03518-7-QST
2	KNOB SHAFT	1-03500-5-QST
3	SET SCREW 1/4-28 × 1/4 SOC. CUP PT.	1-12081-8-QST
4	HANDWHEEL KNOB	1-03499-0-QST
5	SCREW 6/32 × 3/8 PHIL. TRUSS	1-12008-8-QST
6	WASHER 21/64 × 15/32 × .062 STL.	1-12320-7-QST
7	POP RIVET	1-12731-5-QST
8	SPRING WASHER	1-03569-0-QST
9	FOOT PLATE	1-03247-A-QST
10	FOOT PAD	1-03236-6-QST
11	PIVOT RETAINER	1-04589-X-QST
12	O RING	1-12721-6-QST
13	PIVOT RETAINING RING	1-03086-X-QST
14	PIVOT	1-03046-X-QST
15	PIVOT SEAT	1-03060-0-QST
16	LEG LOCK SCREW	1-03265-5-QST
17	LEG LOCK RING	1-04684-X-QST
18	LOWER LEG JOINT BEARING	1-04504-6-QST
19	SCREW 1/4-28 × 3/4 S.H.	1-12148-2-QST
20	LOCK NUT 1/4-28 HEX.	1-12209-2-QST
21	NUT 1/4-28 × 7/16 SQUARE	1-12207-6-QST
22	STRUT YOKE	1-11383-A-QST
23	STRUT YOKE BEARING	1-11633-4-QST
24	HOLD DOWN RING	1-03976-A-QST
25	3/16" ALLEN KEY MOUNT	1-14044-1-QST
26	RUBBER GROMMET	1-12691-1-QST
27	WRENCH MOUNT	1-03577-3-QST
28	O RING BUMPER	1-12720-8-QST
29	COLUMN ASSEMBLY	1-04374-4-QST
30	SCREW SEAT	1-03263-0-QST
31	ELEVATOR PLATE BEARING	1-03404-0-QST
32	COLUMN STOP RING	1-04398-3-QST
33	COLUMN BEARING	1-04392-6-QST
34	BOLT 3/8-24 × 5" HEX. HD.	1-12141-7-QST
35	LOCK NUT 3/8-24	1-12247-2-QST
36	COLUMN KEY	1-03401-6-QST
37	WASHER 9/64 × 7/16 × 1/16 STL.	1-12301-7-QST
38	HANDWHEEL 4-1/2"	1-03254-9-QST
39	DRIVE SHAFT	1-03246-5-QST
40	GROOVE PIN 1/8 × 1/2 TYPE E	1-12565-7-QST
41	WORM	1-11465-X-QST
42	THRUST BEARING	1-12606-9-QST
43	RETAINING RING	1-12509-5-QST
44	WORM GEAR	1-11466-9-QST
45	KEY 1/8 × 1/8 × 9/16 STL.	1-03600-3-QST

10753A TRIPOD MANUFACTURER'S REPLACEABLE PARTS (Continued)

ITEM	DESCRIPTION	PART NO.
46	PINION SHAFT	1-03255-6-QST
47	PINION	1-03251-5-QST
48	BRAKE KNOB	1-04365-2-QST
49	LEG COLLAR	1-04632-5-QST
50	STRUT YOKE SCREW	1-04626-7-QST
51	WASHER 33/64 × 31/32 × .005 BR.	1-12379-3-QST
52	WASHER 1/2 × 11/16 × 1/16 STL.	1-12370-2-QST
53	COLUMN BRAKE SCREW	1-03724-X-QST
54	CLAMP	1-03944-5-QST
55	WASHER 1/2 × 11/16 × 1/32	1-12371-0-QST
56	STRUT	1-04602-8-QST
57	STRUT FOR WRENCH MOUNT	1-04603-6-QST
58	LOWER LEG	1-11198-8-QST
59	STRUT TUBE	1-04601-0-QST
60	SCREW #10-32 × 3/8 PHIL. TRUSS	1-12152-4-QST
61	WASHER 21/64 × 31/64 × 1/32 STL.	1-12319-9-QST
62	WASHER SHIM 3/8 × 5/8 × .005 STL.	1-12378-1-QST
63	PLATE & COVER ASSEMBLY	1-14392-A-QST
64	3/4 UPPER LEG ASSEMBLY	1-14011-A-QST

Part of Figure 6-12. 10753A Tripod, HP Replaceable Parts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20
49
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50
58
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17
57
18
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Figure 6-12. 10753A Tripod Replaceable Parts

Figure 6-12
10753A TRIPOD REPLACEABLE PARTS

(See Page 6-47)

SECTION VII
MANUAL CHANGES

Page

Introduction 7-1
  Newer Instruments 7-1
  Older Instruments 7-1
  5508A Manual Backdating 7-1
  5518A Manual Backdating 7-14
  10751A/B/ Manual Backdating 7-25
  10757A/B/C Manual Backdating 7-26

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information required to update this manual to cover newer or older instruments with serial prefixes different than those shown on the title page.

7-3. Newer Instruments

7-4. Newer instruments may have higher serial number prefixes than those listed in Table 1-1, The manual shipped with a 5528A Laser Measurement System will include a "Manual Updating Changes" sheet that describes all required changes to update the manual. If any of the instruments shipped with the system have a higher serial number than those listed on the title page and the "Manual Updating Changes" sheet does not cover the prefix, contact your local HP Sales and Support Office for information.

7-5. Older Instruments

7-6. Older instruments may have lower serial number prefixes than those listed in Table l-l. The following tables list the serial number prefixes of older instruments that differ from the instruments documented in this manual. Table 7-1 covers 5508A backdating, Table 7-2 covers 5518A backdating, Table 7-3 covers 10751A/B backdating, and Table 7-4 covers 10757A/B/C backdating. Find the prefix in the tables that corresponds to your instrument and make the backdating changes specified.

Table 7-1. 5508A Manual Backdating

If your Instrument Has Serial Prefix or Serial Number	Make Backdating Change
A3 (05508-60003) below Date Code 91195	1
A1 (05508-60001) below Date Code 91212	1,2
A2 (05508-60002) below Date Code 90411	1,2,3
A2 (05508-60002) below Series 3040	1 through 4
5508A, 2948A to Series 2732A	1 through 5
5508A from Series 2732A to 2704A	1 through 6
5508A from Series 2704A to 2648A	1 through 7
5508A from 2648A to 2532A02139	1 through 8
2516A	1 through 9
2512A	1 through 10
2312A	1 through 11
2230A	1 through 12
2220A	1 through 13
2216A,2126A	1 through 14

CHANGE 1 (05508-60003 Date Code 91212)

To backdate the 05508-60003 board from Date Code 91195 to Date Code 91212, make the following changes:

Table 6-3. A3 Counter Board Assembly Replaceable Parts:
Change A3 C14 and C53 from 0160-3874 (10pf) to 0160-4385, CAPACITOR 15PF ±5% 200VDC CER 0±30.
Change A3R2 and R31 from 0757-0180 (31.6 ohms) to 0698-3442, RESISTOR 237 .1% .12W F.

Figure 8-B-21. 5508A Counter Board (05508-60003) Schematic Diagram:
Change A3 C14 & C53 values from 10 pf to 15 pf.
Change A3R2 & R31 values from 31.6 ohms to 237 ohms.

CHANGE 2 (05508-60001 Date Code 90411)

To backdate A1 (05508-60001) from Series 3124A(02797) (Date Code 91212) to Date Code 90411, make the following changes:

Table 1-1. Change 5508A SERIES from 3124A to 90411.
Table 6-3. 5508A A1 Keyboard/Display Board Replaceable Parts:
Change A1U1 and U8 from 1820-4688 to 1820-2132.
Figure 8-B-5. A1 Keyboard/Display Board Schematic Diagram:
Change A1U1, U8 from 1820-4688 to 1820-2132, ICM7218A, in Table of Active Elements .

CHANGE 3

To backdate the 05508-60002 from Date Code 90411 to Series 3040, make the following changes:

Table 6-3. A2 Processor Board Assembly Replaceable Parts:
Delete A2C6, C7, .01UF CAPACITOR.

Page 8-B-19. Processor Board Test Switch, Troubleshooting Procedures:
Change step b to read:
Perform Test 2 in Paragraph 8-B-83. If OK go to h, else c.
Add steps c thru g.

c. Are U10 pins 7-11 signatures OK? If not go to h. else d.
d. Perform Test 7 in Paragraph 8-B-91a. If bad, replace U9, else e.
e. Perform Test 8 in Paragraph 8-B-91c. If bad, go to step g. else f.
f. Perform Test 9 in Paragraph 8-B-91e. If bad, replace U5, else replace U8.
g. Perform Test 9 in Paragraph 8-B-91e. If bad, replace U6 else replace U7.

Page 8-B-20. Processor Board Test Switch, Troubleshooting Procedures:
Add Tests 7 thru 9 in Table 8-B-2.

Table 8-B-2. Summary of 5508A Processor Board A2 Signature Analysis Tests

Test #	Test Switch A2S3 Switch Position	Circuitry Under Test
7	00000101	F800 ROM: U9
8	00000110	E000 & E800 ROMS: U6, U7
9	00000111	E000 & C000 ROMS: U6, U5

CHANGE 3 (Continued)

Change the following Kernal Signatures to read as indicated:

U13 Pin No.
29: UP74
30: AI8H
30 ACF0

Add the following to the end of paragraph 8-B-81, "If signatures are still incorrect., move A2 JMP1 to TEST. Correct signatures indicate faulty U10 or its inputs."

Page 8-B-22. TEST 2. All ROMS Test:

Change paragraph 8-B-84 to read as follows:

8-B-84. This test verifies operation of U5, U6, U7, U8, and U9 assuming that the kernel is functioning properly. All ROM locations are read and data bus signatures are checked to confirm ROM contents. ROM memory is divided into parts by test 7, 8, and 9. These should be used only if incorrect signatures are observed on the data bus during this test.

Add "JMP1:NORM" under test switch diagram.
Add kernal signature column for U10.

U10 Pin No.
7: 91C4
9: 774F
10: F0HH
11: 6644

Change "4068" to "4068" under U11 Pin No.

Page 8-B-23. 5508A Measurement Display:

Add "JMP1:NORM" under test switch diagram.
Add signature kernel column for U10.

U10 Pin No.
7: 67F5
9: 8HH5
10: U831
11: PH66

Change "P268" to "1H2U" under U11 Pin No.

Page 8-B-24. 5508A Measurement Display:

Add "JMP1:NORM" under test switch diagram.

Page 8-B-25. 5508A Measurement Display:

Change U4 input 14 to read as follows: 14: F599 (2163 with VELOCITY key)

Page 8-B-26. Test 6. Interrupt Encoder Test:

Add "JMP1:NORM" under test switch diagram.

Page 8-B-27 Tests 7, 8, and 9. ROM Tests:

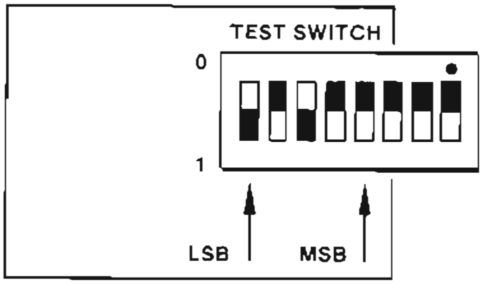
Add paragraphs 8-B-91, Tests 7, 8, and 9. ROM Tests

CHANGE 3 (Continued)

8-B-91. Tests 7, 8, and 9. ROM Tests

8-B-92. Use these tests when Test 2 indicates a possible ROM failure. The tests are designed to isolate trouble to U5, U6, U7, U8, or U9.

a. For test 7, set Processor Board A2 switches and jumpers as follows:



JMP1: NORM
JMP2: Installed

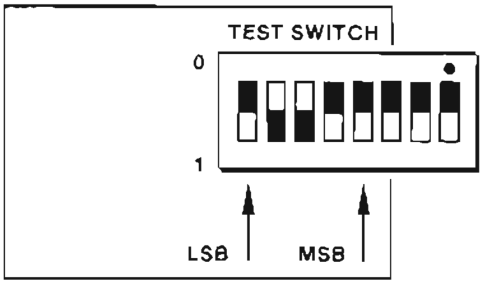
b. Toggle MASTER PRESET switch and measure signatures at the following nodes:

+5 V Test Signature: H8U4

U13 Pin No.
30: 139U
31: 38F4
32: 2595
33: 4PUC
34: UHU0
35: CHFH
36: 4U36
37: P12U

If test 7 yields incorrect signatures, replace U9 and verify all ROM tests.

c. For test 8, set the TEST SWITCH A2S3 as shown below.



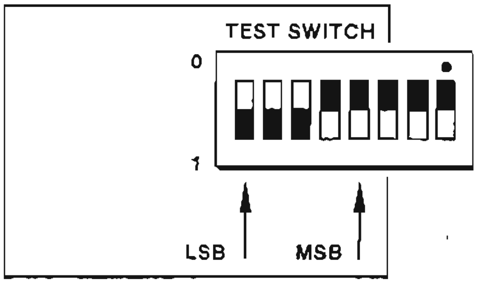
CHANGE 3 (Continued)

d. Toggle MASTER RESET switch and measure signatures at the following nodes:

+5V Test Signature: 4OUO

U13 Pin No.
30: 2P60
31: 0553
32: OCH3
33: 84C9
34: 3H24
35: 3033
36: 9372
37: 697C

e. For test 9, set TEST SWITCH A2S3 as shown below:



f. Toggle MASTER RESET switch and measure signatures at the following nodes:

+5V Test Signature: 237C

U13 Pin No.
30: 2A7U
31: AP7F
32: 81U2
33: PA4F
34: 20F7
35: 41UC
36: C8P2
37: H536

If test 9 is OK, but test indicates a failure, replace U7. If test 9 gives the indication of failure, replace U5. If both tests indicate a failure, replace U6. If tests 7, 8, and 9 give correct signatures and test 2 indicates a failure, then replace U8.1

CHANGE 3 (Continued)

Page 8-B-30. 5508A Measurement Display:
Change U13 signatures to read as indicated:

U13 Pin No.
30: PU68
31: 2A54
32: 8A1U
33: U2CU
34: 796U
35: UFU6
36: 2183
37: 102C

CHANGE 4 (05508-60002 Series 2732A)

To back date from Series 3040A to 2732A, make the following changes:

Page 1-3, General Information
Change 5508A SERIES to 2732A in Table 1-1.

Figure. 8-B-18. 5508A A2 Processor Board Component Locator/Schematic Diagram:
Replace A2 (05508-60002) component locator/schematic diagram with Figure 7-1 supplied in these manual changes.

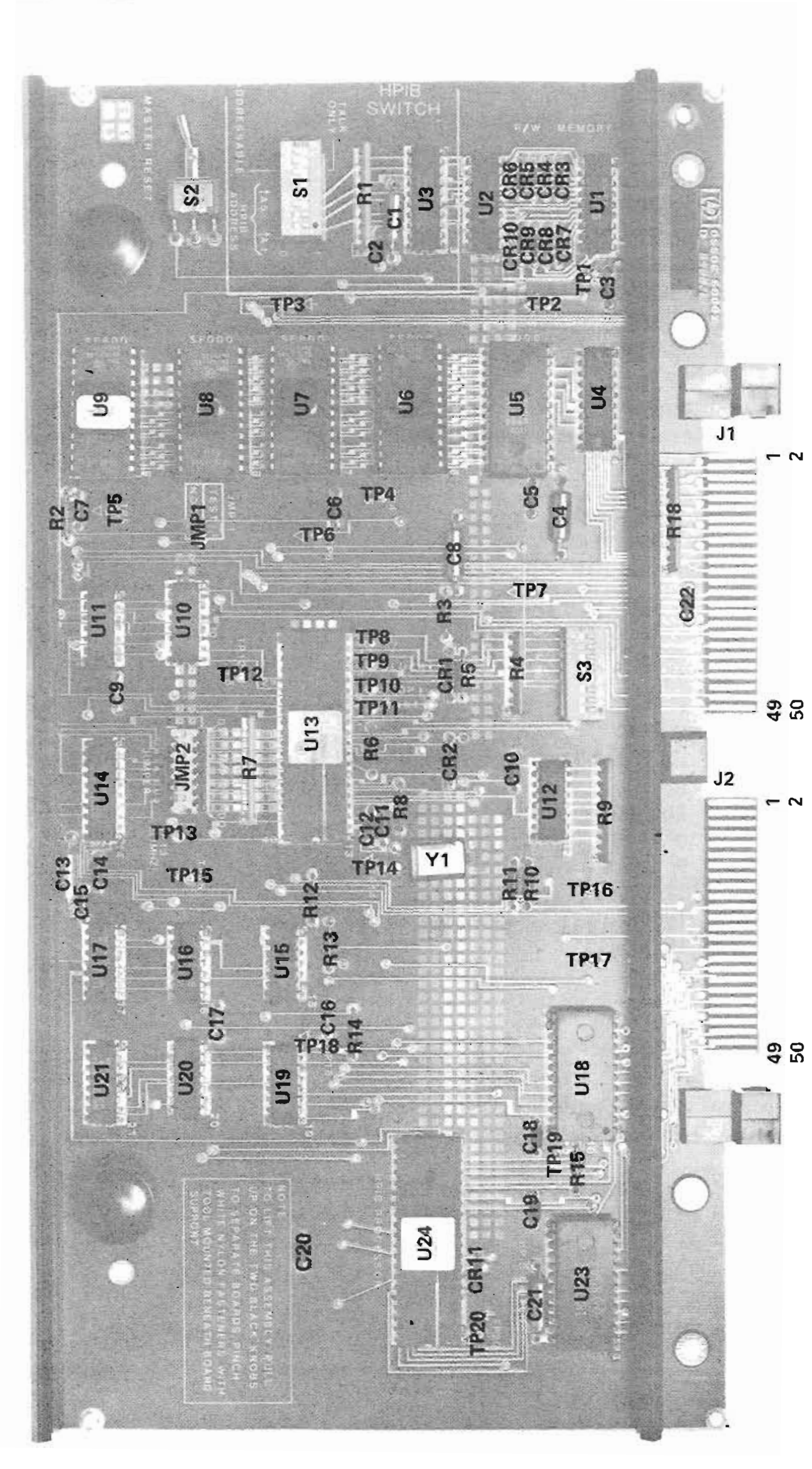
CHANGE 5 (5508A SERIAL PREFIX 2732A)

To backdate from Series 2948A to Series 2732A, make the following changes:

Page 6-23, 5508A Cabinet Replaceable Parts:
Change MP1 Top Cover P/N from 5062-3730 to 5061-9430.
Change MP2 Top Trim P/N from 5041-8803 to 5040-7203.
Change MP5 Side Cover P/N from 5062-3761 to 5061-9461.
Change MP12 Bottom Cover P/N from 5062-3742 to 5061-9442.
Change MP13 Foot Non-Skid P/N from 5041-8822 to 5040-7222.
Change MP15 Foot P/N from 5041-8801 to 5040-7201.

Page 6-31, 5508A Front Panel Replaceable Parts:
Change MP2 Frame-Front P/N from 5021-8417 to 5020-5817.

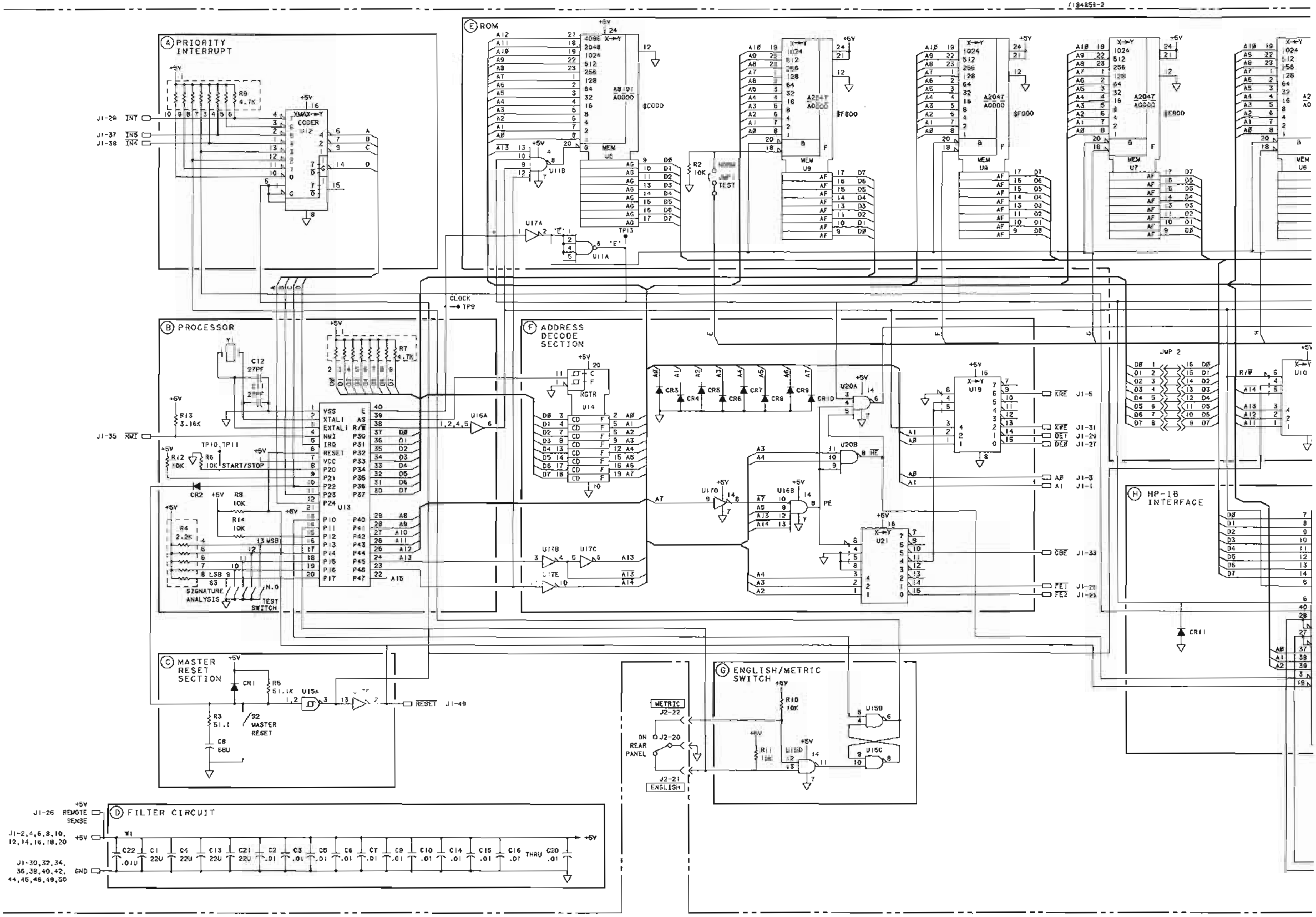
Page 6-33, 5508A Rear Panel Replaceable Parts:
Change MP22 Rear Power Cord Wrap P/N from 5041-8813 to 5040-7213.


HPIB SWITCH
S2
S1
R1
C1
C2
U3
U2
CR6
CR5
CR4
CR3
CR10
CR9
CR8
CR7
U1
TP1
C3
TP3
TP2
U9
U8
U7
U6
U5
U4
J1
1
2
R2
C7
TP5
JMP1
C6
TP6
TP4
C8
C5
C4
R18
TP7
R3
C22
U11
U10
TP12
TP8
TP9
TP10
TP11
CR1
R5
R4
S3
49
50
C9
U13
U14
JMP2
R7
R6
CR2
C10
U12
R9
J2
1
2
TP13
C12
C11
R8
Y1
TP14
C13
C15
C14
TP15
R12
R11
R10
TP16
U17
U16
U15
R13
TP17
C17
C16
R14
TP18
U21
U20
U19
U18
49
50
C18
TP19
R15
C19
C20
U24
CR11
U23
C21
TP20

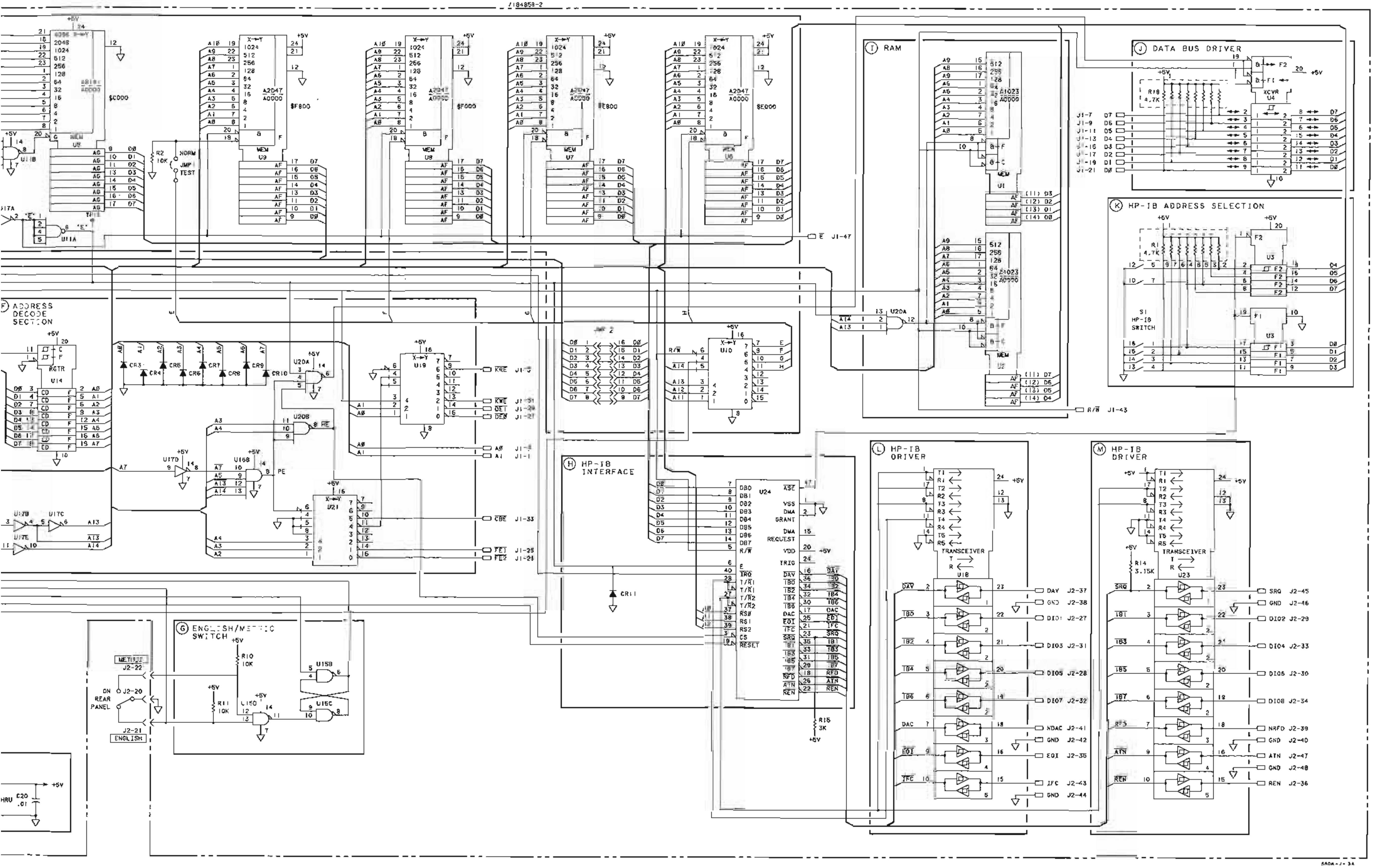
A2 5508 PROCESSOR BD (05508-60002) SERIES 2108

J1 PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	A1	TO A3J1-1	Ⓕ
2	+5V	FROM A5J1-2	Ⓓ
3	A0	TO A3J1-2	Ⓕ
4	+5V	FROM A5J1-4	Ⓓ
5	KRE	TO A1J1-5	Ⓕ
6	+5V	FROM A5J1-6	Ⓓ
7	D7	TO/FROM A1J1-7 & A3J1-7	Ⓙ
8	+5V	FROM A5J1-8	Ⓓ
9	D6	TO/FROM A1J1-9 & A3J1-9	Ⓙ
10	+5V	FROM A5J1-10	Ⓓ
11	D5	TO/FROM A1J1-11 & A3J1-11	Ⓙ
12	+5V	FROM A5J1-12	Ⓓ
13	D4	TO/FROM A1J1-13 & A3J1-13	Ⓙ
14	+5V	FROM A5J1-14	Ⓓ
15	D3	TO/FROM A1J1-15 & A3J1-15	Ⓙ
16	+5V	FROM A5J1-16	Ⓓ
17	D2	TO/FROM A1J1-17 & A3J1-17	Ⓙ
18	+5V	FROM A5J1-18	Ⓓ
19	D1	TO/FROM A1J1-19 & A3J1-19	Ⓙ
20	+5V	FROM A5J1-20	Ⓓ
21	D0	TO/FROM A1J1-21 & A3J1-21	Ⓙ
22	NC	—	—
23	$\overline{\text{FE2}}$	TO A3J1-23	Ⓕ
24	NC	—	—
25	$\overline{\text{FE1}}$	TO A3J1-25	Ⓕ
26	+5VREMOTE SENSE	FROM A5J1-26	Ⓓ
27	$\overline{\text{DE0}}$	TO A1J1-27	Ⓕ
28	$\overline{\text{IN7}}$	FROM A3J1-28	Ⓐ
29	$\overline{\text{DE1}}$	TO A1J1-29	Ⓕ
30	GND	FROM A5J1-30	Ⓓ
31	$\overline{\text{KWE}}$	TO A1J1-31	Ⓕ
32	GND	FROM A5J1-32	Ⓓ
33	$\overline{\text{CBE}}$	TO A3J1-33	Ⓕ
34	GND	FROM A5J1-34	Ⓓ
35	NMI	FROM A3J1-35	Ⓑ
36	GND	FROM A5J1-36	Ⓓ
37	$\overline{\text{IN5}}$	FROM A1J1-37	Ⓐ
38	GND	FROM A5J1-38	Ⓓ
39	$\overline{\text{IN4}}$	FROM A3J1-39	Ⓐ
40	GND	FROM A5J1-40	Ⓓ
41	NC	—	—
42	GND	FROM A5J1-42	Ⓓ
43	R/W	TO A3J1-43	Ⓘ
44	GND	FROM A5J1-44	Ⓓ
45	NC	—	—
46	GND	FROM A5J1-46	Ⓓ
47	E	TO A1J1-47 & A3J1-47	Ⓔ
48	GND	FROM A5J1-48	Ⓓ
49	RESET	TO A3J1-49	Ⓒ
50	GND	FROM A5J1-50	Ⓓ

J2 PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	NC		
2	NC		
3	NC		
4	NC		
5	NC		
6	NC		
7	NC		
8	NC		
9	NC		
10	NC		
11	NC		
12	NC		
13	NC		
14	NC		
15	NC		
16	NC		
17	NC		
18	NC		
19	NC		
20	ENG-MET GND	TO A4J1-20	Ⓖ
21	ENGLISH SW	FROM A4J1-21	Ⓖ
22	METRIC SW	FROM A4J1-22	Ⓖ
23	NC		
24	NC		
25	NC		
26	NC		
27	DIO1	TO/FROM J2-1	Ⓛ
28	DIO5	TO/FROM J2-13	Ⓛ
29	DIO2	TO/FROM J2-2	Ⓜ
30	DIO6	TO/FROM J2-14	Ⓜ
31	DIO3	TO/FROM J2-3	Ⓛ
32	DIO7	TO/FROM J2-15	Ⓛ
33	DIO4	TO/FROM J2-4	Ⓜ
34	DIO8	TO/FROM J2-16	Ⓜ
35	EOI	TO/FROM J2-5	Ⓛ
36	REN	TO FROM J2-17	Ⓜ
37	DAV	TO/FROM J2-6	Ⓛ
38	DAV GND	FROM J2-18	Ⓛ Ⓜ
39	NRFD	TO/FROM J2-7	Ⓜ
40	NRFD GND	FROM J2-19	Ⓛ Ⓜ
41	NDAC	TO/FROM J2-8	Ⓛ
42	NDAC GND	FROM J2-20	Ⓛ Ⓜ
43	IFC	TO/FROM J2-9	Ⓛ
44	IFC GND	FROM J2-21	Ⓛ Ⓜ
45	SRQ	TO/FROM J2-10	Ⓜ
46	SRQ GND	FROM J2-22	Ⓛ Ⓜ
47	ATN	TO/FROM J2-11	Ⓜ
48	ATN GND	FROM J2-23	Ⓛ Ⓜ
49	SHIELD	FROM J2-12	Ⓛ Ⓜ
50	SIGNAL GND	FROM J2-24	Ⓛ Ⓜ



/184853-2
Ⓐ PRIORITY INTERRUPT
Ⓑ PROCESSOR
Ⓒ MASTER RESET SECTION
Ⓓ FILTER CIRCUIT
Ⓔ ROM
Ⓕ ADDRESS DECODE SECTION
Ⓖ ENGLISH/METRIC SWITCH
Ⓗ HP-IB INTERFACE
J1-28 IN7
J1-37 IN5
J1-38 IN4
J1-35 NMI
R9 4.7K
XMAX→Y CODER U12
+5V
CLOCK TP9
R7 4.7K
R13 3.16K
TP10, TP11
R12 10K
R6 10K START/STOP
CR2
R8 10K
R14 10K
R4 2.2K
13 MSB
8 LSB
S3
SIGNATURE ANALYSIS
TEST SWITCH
N.O.
VSS
XTAL1
EXTAL1
NMI
IRQ
RESET
VCC
P20
P21
P22
P23
P24
P10
P11
P12
P13
P14
P15
P16
P17
E
AS
R/W
P30
P31
P32
P33
P34
P35
P36
P37
P40
P41
P42
P43
P44
P45
P46
P47
U13
C12 27PF
Y1
U16A
A15
CR1
R5 51.1K
U15A
RESET J1-49
R3 51.1
S2 MASTER RESET
C8 68U
J1-26 REMOTE SENSE
J1-2,4,6,8,10,12,14,16,18,20
J1-30,32,34,36,38,40,42,44,45,46,49,50
+5V
GND
W1
C22 .01U
C1 22U
C4 22U
C13 22U
C21 22U
C2 .01
C3 .01
C5 .01
C6 .01
C7 .01
C9 .01
C10 .01
C14 .01
C15 .01
C16 .01
THRU
C20 .01
4096
2048
1024
512
256
128
64
32
16
8
4
2
1
X→Y
A9191 A0000
$C000
MEM U5
U11B
U17A
U11A
TP13
'E'
R2 10K
NORM
JMP1
TEST
A2047 A0000
$F800
MEM U9
$F000
MEM U8
$E800
MEM U7
MEM U6
RCTR U14
CR3
CR4
CR5
CR6
CR7
CR8
CR9
CR10
U20A
U20B
HE
U17D
U16B
PE
U17B
U17C
U17E
A13
A14
X→Y U19
X→Y U21
KRE J1-5
KWE J1-31
DE1 J1-29
DE0 J1-27
A0 J1-3
A1 J1-1
CBE J1-33
FE1 J1-25
FE2 J1-23
JMP 2
R/W
U10
CR11
METRIC J2-22
ON REAR PANEL
J2-20
J2-21 ENGLISH
R10 10K
R11 10K
U15D
U15B
U15C


A ADDRESS DECODE SECTION
G ENGLISH/METRIC SWITCH
H HP-IB INTERFACE
I RAM
J DATA BUS DRIVER
K HP-IB ADDRESS SELECTION
L HP-IB DRIVER
M HP-IB DRIVER
$C000
$F800
$F000
$E800
$E000
U8 U9 U7 U6 U1 U2 U3 U4 U10 U11 U12 U14 U15 U16 U17 U18 U19 U20A U21 U23 U24
S1 HP-IB SWITCH
JMP 2
NORM JMP TEST
METRIC J2-22
ON REAR PANEL
J2-21 ENGLISH
TRANSCEIVER
XCVR

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN FARADS;
   INDUCTANCE IN HENRIES
3. ASTERISK(*) INDICATES SELECTED COMPONENT. AVERAGE VALUES SHOWN

Reference Designations
C1-22
CR1-11
JMP1 2
R1-15, 18
S1-3
TP1-20
U1-21 23, 24
Y1

Deleted: R16, R17, U22

TABLE OF ACTIVE ELEMENTS

Reference Desig.	HP Part No.	Mfr Part No.
U1-2	1818-0438	TMS2114-45NL
U3	1820-2024	SN74LS244N
U4	1820-2075	SN74LS245N
U5	1820-1469	MK3600-5 Masked
U6	1818-1516	TMS2516JL Programmed
U7	1818-1517	TMS2516JL Programmed
U8	1818-1518	TMS2516JL Programmed
U9	1818-1519	TMS2516JL Programmed
U10 19, 21	1820-1216	SN74LS138N
U11	1820-0688	SN74S20N
U12	1820-2121	SN74LS348N
U13	1820-2562	1820-2562
U14	1820-2102	SN74LS373N
U15	1820-1425	SN74LS132N
U16	1820-1205	SN74LS21N
U17	1820-0683	SN74S04N
U18 23	1820-2424	MC3447P
U20	1820-1202	SN74LS10N
U24	1820-2113	MC68488L

Figure 7-1. 5508A A2 Processor Board (05508-60002)

Figure 7-1

5508A A2 PROCESSOR BOARD (05508-60002)

(See Page 7-7)

CHANGE 6 (5508A Series 2704A)

To backdate the 5508A from Series 2732A to 2704A, make the following changes:

Page 1-3. General Information
Change 5508A SERIES from 2732 to 2704A in Table 1-1.

Pages 6-5/6-6, Table 6-3. A2 Processor Board Assembly Replaceable Parts:
Change A2 (05508-60002) SERIES from 2732 to 2704
Change A2U5 from 05508-80005 to 1818-1469.
Change A2U6 from 05508-80006 to 1818-1516.
Change A2U7 from 05508-80007 to 1818-1517.
Change A2U8 from 05508-80008 to 1818-1518.
Change A2U9 from 05508-80009 to 1818-1519.

Page 8-B-21. 5508A measurement display:
Change the following Kernel Signatures to read as indicated; all others remain the same.

U13 Pin No.	U14 Pin No.
28: UP72	6: 7A81
31: 228P	9: 07U2
33: 0095	12: 024C
34: ACF0	15: U24H
	16: 024C
	19: 024C

Page 8-B-22. Test 2. All Roms Test:
Change the following "A11 ROM Test" signatures to read as indicated. All others remain the same.

U13 Pin No.	U14 Pin No.
29: 2170	6: 44A1
30: U817	9: 1HAC
31: 0418	12: PP06
32: 80CC	15: 75F0
33: 1F7U	16: 476F
34: 6202	
35: H725	
36: 32A9	
37: 1FH7	

Page 8-B-23. 5508A Measurement Display:
Change the following "Decode Test" signatures to read as indicated. All others remain the same.

U14 Pin No.	U13 Pin No.	U17 Pin No.
6: P9CP	28: 77U3	8: 7A1F
9: 628H		
12: 6507		
15: A264		
16: 8499		
19: 4380		

Page 8-B-24. 5508A Measurement Display:
Change the following "A11 RAM Test" signatures to read as indicated. All others remain the same.

U13 Pin No.
31: 938C
33: 4C60
34: 8C81

CHANGE 6 (Continued)

Page 8-B-25. 5508A Measurement Display:
Change only the following "U4 INPUTS" signatures to read as indicted. All others remain the same.

14: F599 (2163 with velocity key)
15: 9HFH (7937 with angle key)
17: 902C (74H1 with short key)

Page 8-B-28. 5508A Measurement Display:
Change the following signatures to read as indicated.

(Para b.) **U13 Pin No.**	(Para d.) **U13 Pin No.**
30: 139U	30: 2P60
31: 38F4	31: 0553
32: 2595	32: 0CH3

Page 8-B-29. 5508A Measurement Display:
Change the following signatures to read as indicated:

U13 Pin No.
30: PC1P
31: 9UU0
32: H145
33: 2CP5
34: H68F
35: C105
36: H120
37: 2029

Page 8-B-30. 5508A Measurement Display:
Change the following signatures to read as indicated. All others remain the same:

U3 Pin No.
31: 2A54
33: U2CU
34: 796U

Page 8-B-45, Fig. 8-B-18. 5508A A2 Processor Board Component Locator/Schematic Diagram:
Change "Table of Active Elements" to reflect the ROM changes for A2U5 thru A2U9.

CHANGE 7 (5508A Series 2648A)

To backdate the 5508A from Series 2704A to 2648A

Page 1-13. General Information:
Change paragraph 1-29 to read:
1-29. The 5508A Measurement Display (Figure 1-2) is supplied with Interconnect Cable 8120-3491 and Remote Control Unit 05508-60021.

Page 2-5. Installation:
2-12. 5518A to 5508A Interconnecting Cable:
Change HP Cable Part Number from 10793A/B/C to 8120-3491.

Page 4-2. Performance Tests And Calibration:
4-18. Procedure:
Change HP Cable Part Number from 10793A/B/C to 8120-3491.

CHANGE 8 (5508A Series 2532A)

To backdate the 5508A from 2648A to 2532A02139

Change 5508A SERIES to 2532A in Table 1-1.

Page 1-9, Table 1-2. Specifications And Supplemental Characteristics (Cont'd):

Add the following to ANGLE MEASUREMENTS, Angle Measurement Accuracy:

This assumes that all angles. greater than ±3600 arc-sec have been corrected, the Reflector is aligned within 10 arc-min using autoreflection techniques, roll alignment by the operator is within 1 degree relative to the measurement plane, and the temperature of all optical components is stabilized in the range 15-25°c.

Angle Measurement Range:
Change ±36000 to ±3600.
Add the following:
±36000 arc-sec with angle correction: corrected angle - arcsin (displayed angle).

Page 8-B-45, Fig. 8-B-18. 5508A A2 Processor Board Component Locator/Schematic Diagram:

Change A2 (05508-60002) SERIES to 2532.

CHANGE 9 (5508A SERIAL PREFIX 2516A)

5508A Measurement Displays with Serial Prefix 2516A differ from later versions as follows:

Block D of Figure 8-B-32 had two capacitors (A5C1 and A5C16) voltage ratings upgraded.

To backdate this manual to be applicable to 5508A instruments with Serial Prefix 2516A, make the following changes:

Page 1-3, Table 1-1. 5528A Equipment and Manual Serial Prefix Effectivity:
Change 5508A Measurement Display serial prefix from 2628A to 2516A.

Page 6-12, Table 6-3. 5508A P.C. Board Assemblies Replaceable Parts:

Change A5C1 part number from 0180-3579 to 0180-0533, CAPACITOR-FXD 50OUF+75-10% 40 VDC AL, Mfr Code 28480, Mfr Part Number 0180-0533. Note: The capacitor with part number 0180-0533 has a lower voltage rating than capacitor 0180-3579.

Change A5C16 part number from 0180-3419 to 0180-2800, CAPACITOR-FXD .01F+75 VDC AL, Mfr Code 28480, Mfr Part Number 0180-2800. Note: The capacitor with part number 0180-2800 has a lower voltage rating than capacitor 0180-3419.

Page 8-B-115, Figure 8-B-32. 5508A A5 Power Supply Board Schematic Diagram:

Change board series number, located at the upper left-hand corner of the schematic, from 2628 to 2228.

CHANGE 10 (5508A SERIAL PREFIX 2512A)

5508A Measurement Displays with Serial Prefix 2512A differ from later versions as follows:

a. Block P of Figure 8-B-21 (sheet 2 of 5) has had several resistor value changes (R30, R31, and R32).
b. Block K of Figure 8-B-21 (sheet 3 of 5) has had several resistor value changes (R1, R2, and R3).

To backdate this manual to be applicable to 5508A instruments with Serial Prefix 2512A, make the following changes:

Page 1-3, Table 1-1. 5528A Equipment and Manual Serial Prefix Effectivity:
Change 5508A Measurement Display serial prefix from 2516A to 2512A.

Page 6-9, Table 6-3, 5508A P.C. Board Assemblies Replaceable Parts:
Change A3R1, A3R3, A3R30, and A3R32 from 0698-4002 to 0757-0449, RESISTOR 20K 1% .125W F TC=0±100, 24546, C4-1/8-TO-2002-F.
Change A3R2 and A3R31 from 0698-3442 to 0698-3445, RESISTOR 348 1% .125W F TC=0±100, 24546, C4-1/8-TO-348R-F.

Page 8-B-73, Figure 8-B-21, 5508A A3 Counter Board 05508-60003:
Change A3R30 and A3R32 (of Block P) from 5K to 20K.
Change A3R31 (of Block P) from 237 to 348 Ohms.

Page 8-B-75, Figure 8-B-21, 5508A A3 Counter Board 05508-60003:
Change A3R1 and A3R3 (of Block K) from 5K to 20K.
Change A3R2 (of Block K) from 237 to 348 Ohms.

Page 8-B-71, Figure 8-B-21, 5508A A3 Counter Board 05508-60003:
Change board series number located in upper left corner of schematic to 2108.

CHANGE 11 (5508A SERIAL PREFIX 2312A)

5508A Measurement Displays with Serial Prefix 2312A differ from later versions as follows:

The cabinet hardware in later versions of the 5508A has been changed from "Inch" to "Metric".

To backdate this manual to be applicable to 5508A instruments with Serial Prefix 2312A, make the following changes:

Page 1-3, Table 1-1. 5528A Equipment and Manual Serial Prefix Effectivity:
Change 5508A Measurement Display serial prefix from 2512A to 2312A.

Page 6-23, Figure 6-1, 5508A Cabinet Parts Exploded View:
Change Item 1 HP Part Number from 5061-9430 to 5060-9830. Delete "Metric" reference in part description.
Change Item 5 HP Part Number from 5061-9461 to 5060-9861. Delete "Metric" reference in part description.
Change Item 6 HP Part Number from 5061-5836 to 5020-8836. Delete "Metric" reference in part description.
Change Item 11 HP Part Number from 0515-1331 to 2510-0192. Modify part description to read SCREW, MACH, 8-32 X 0.25", 1000.
Change Item 12 HP Part Number from 5061-9442 to 5060-9842. Delete "Metric" reference in part description.

Page 6-31, Figure 6-5, 5508A Front Panel Exploded View:
Change Item 2 HP Part Number from 5020-5817 to 5020-8817. Delete "Metric" reference in part description.
Change Item 3 HP Part Number from 2360-0119 to 2360-0115. Modify part description to read SCREW-MACH 6-32 - 5/16 PH.

CHANGE 11 (Continued) (5508A SERIAL PREFIX 2312A)

Page 6-33, Figure 6-6, 5508A Rear Panel Exploded View:

Change Item 19 HP Part Number from 5021-5818 to 5020-8818. Delete Metric reference in part description.

Change Item 23 HP Part Number from 0515-1233 to 2360-0321. Modify part description to read SCREW-MACH 6-32 X 1 PH.

Change Item 11 HP Part Number from 0515-1331 to 2510-0192. Modify part description to read SCREW, MACH, 8-32 X 0.25", 1000.

NOTE

Some 5508A instruments with serial number prefix of 2312A and all later serial prefixed instruments have been upgraded as follows:

A3U65 part number has changed from 1826-0746 to 1826-1053. The later part is preferred due to its improved environmental performance. At the same time, two washers (3050-0016) were added between the screw head and the A3 printed circuit board on the two nylon latches. This change did not affect the instrument's serial prefix.

CHANGE 12 (SERIAL PREFIX 2230A)

5508A Measurement Displays with Serial Prefix 2230A differ from later versions as follows:

Had part number 1251-3448 for J7. Later versions use part number 1251-8247.
To backdate this manual to be applicable to 5508A instruments with Serial Prefix 2230A, make the following changes:

Page 6-11, Table 6-3, Replaceable Parts:

Change part number of A4J7 to 1251-3448. Description is the same.

CHANGE 13 (5508A SERIAL PREFIX 2220A)

5508A Measurement Displays with instrument Serial Prefix 2220A differ from later versions as follows:

A5R35 and A5CR17 are not installed on the 05508-60005 Power Supply Board.

To backdate this manual to be applicable to 5508A instruments with Serial Prefix 2220A, make the following changes:

Pages 6-12 and 6-13, Table 6-3, 5508A P.C. Board Replaceable Parts:

Delete A5CR17 and A5R35.

Page 8-B-115, Figure 8-B-32, 5508A Power Supply Board 05508-60005, Schematic Diagram: In Block F, near U1, delete A5R35 and replace with a straight-through connection.

Delete A5CR17. Change the board series number to 2220.

CHANGE 14 (5508A SERIAL PREFIX 2126A AND 2216A)

5508A Measurement Displays with instrument Serial Prefix 2126A and 2216A differ from later versions as follows:

a. Has a Series 2108 Power Supply Board for A5 05508-60005. This board has diode pack A5CR4 instead of the two discrete diodes A5CR15 and A5CR16 that are used in later versions. Series 2108 Power Supply boards also have a 17,000µF capacitor for A5C11 instead of the 25,000µF value used in later versions.

b. Has a Series 2108 Controller Board for A3 05508-60003. This board uses 1K resistors for A3R14, A3R19, and A3R34 instead of 2k resistors used in later versions.

To backdate this manual to be applicable to 5508A instruments with Serial Prefix 2126A, make the following changes:

Page 6-12, Table 6-3, Replaceable Parts:
Change A5C11 to 0180-2799, CF 17,000UF -75%-10% 20VDC AL, Mfr Code 28480, Mfr Part Number 0180-2799.
Delete A5CR15 and A5CR16. Add A5CR4 1904-0214 DIODE, DUAL CT-RECTIFIER Mfr Code 01295, Mfr Part Number TIR201B.

Page 6-9, Table 6-3, Replaceable Parts:
Change A3R14, A3R19, and A3R34 to 0757-0280, RF 1K 1% 0.125W, Mfr Code 24546, Mfr Part Number C4-1/8-TO-1001-F.

Page 8-B-115, Figure 8-B-32, 5508A A5 Power Supply Schematic Diagram:
In Block D, the 15 Volt Rectifier, replace A5CR15 and A5CR16 with A5CR4 shown in the partial diagram in Figure 7-1. In Block 1, the +5 Volt Filter, change A5C11 to 17,000 UF. In the upper left corner of the schematic, change the series number of the board to 2108.

Page 8-B-13, Figure 8-B-21, Sheet 1, 5508A A3 Counter Board:
Change A3R14, A3R19, and A3R34 to 1K. In the upper left corner of the schematic, change series to 2108.

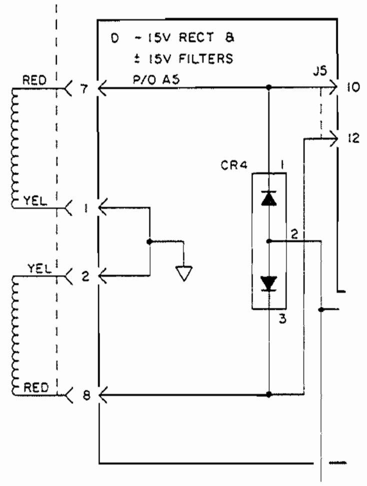


Figure 7-2. 5508A Power *Supply Changes, Instrument Serial Prefix 2216A, A5 Power Supply Board Series 2108*

Table 7-2. 5518A Manual Backdating

If Your Instrument Has Serial Prefix or Serial Number	Make Backdating Change
A3 (05518-60003) below Date Code 91013	1
A1(05518-60001) below Date Code 90232	1, 2
5518A Laser Heads, Serial Number 3020A03374 & above	1,2, 3
5508A SERIES from 3020A to 2948A	1 through 4
5518A below 2532A02139	1 through 5
2520A	1 through 6
2502A	1 through 7
2408A	1 through 8
2332A	1 through 9
2328A	1 through 10
2308A	1 through 11
2236A	1 through 12
2220A	1 through 13

CHANGE 1 (05518-60003 Series 2332)

To backdate the 05518-60003 from Date Code 91013 to Series 2332.

Table 6-4. A3 Controller/Reference Board Replaceable Parts:
Change A3Q3 from 1853-0347 to 1853-0332, TRANSISTOR PWRDAR 1091.

Figure 8-C-14. 5518A A3 Controller/Reference Board (05518-60003):
Table of Active Elements:
Change A3 from 1853-0347, MJE700, to 1853-0332, MJE71091.

CHANGE 2 (05518-60001, Series 2216)

To backdate from 05518-60001 Date Code 90232 to Series 2216, make the following changes:

Page 5-1, Adjustments:
Add the following Note under Warning:

NOTE

The High Voltage Power Supply, A5, is defeated automatically by A1S2, when the 5518A cover is removed. For Adjustments and Servicing purposes, the High Voltage Supply can be re-enabled by setting the TEST-NORM switch, A1S1, to TEST after the 5518A cover is remove.

Page 5-2, 5518A Receiver Adjustments:
Add the following after step c in paragraph 5-14:
At the rear of the Laser Head, on Connector Board A1, set the NORM-TEST switch to TEST. See Figure 7-3.

CHANGE 2 (Continued)

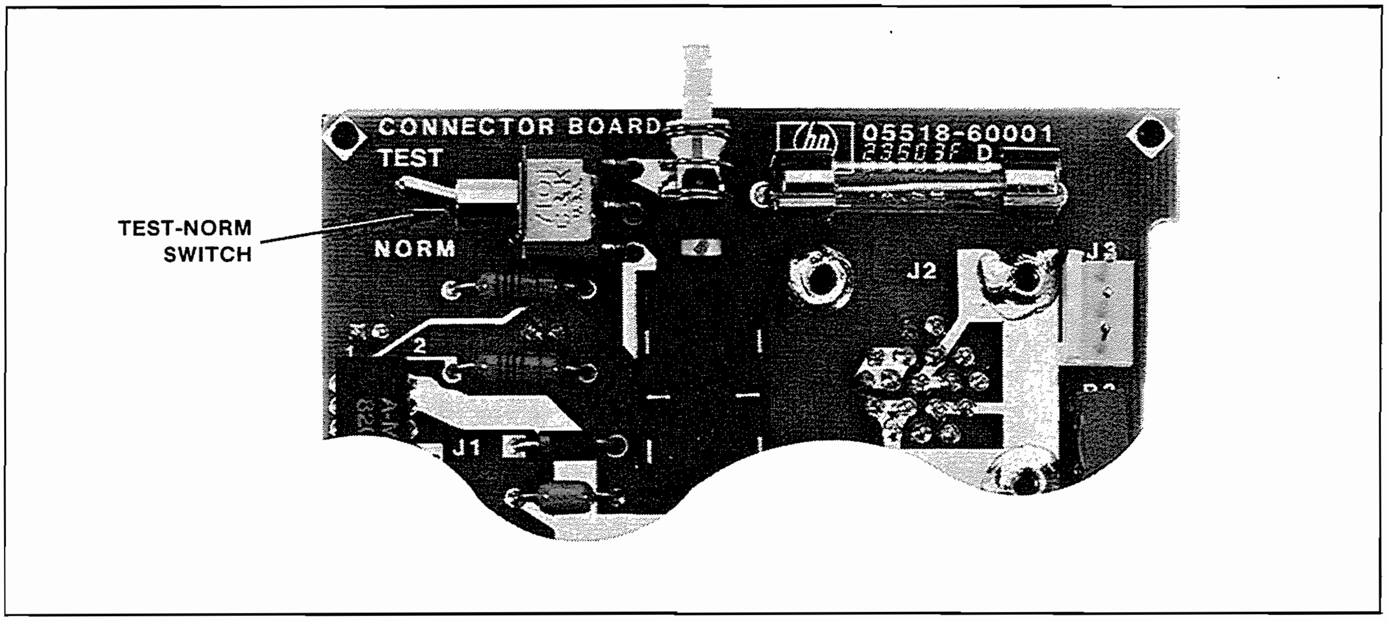


Figure 7-3. A1 Connector Board NORM/TEST Switch Location

Page 5-3, 5518A Receiver Adjustments:
Replace step g with the following:
g. Set the NORM-TEST switch to NORM and replace the Laser Head top cover.

Page 5-4, 5518A Reference Temperature Adjustments:
Add the following after 5-20, step b:
At the rear of the Laser Head, on Connector Board A1, check that the NORM-TEST switch is set to NORM. See Figure 7-3.

Page 5-5. 5518A Laser Tube Current Adjustment:
Add the following after step c:
On the A1 Connector Board, set TEST-NORM switch to TEST. See Figure 7-3.

Page 5-6. 5518A Laser Tube Current Adjustment:
Change step k to read as follows:
k. Set the 5508A LINE switch to OFF, disconnect the probe, set the TEST-NORM switch to NORM and reinstall the Laser Head Cover.

Page 6-14, Table 6-4. A1 Connector Board Assembly Replaceable Parts:
Add A1S1, part number 3101-2413, Qty 1, SWITCH-PUSHBUTTON DPDT MOM 4A 250VAC.
Add A1S2, part number 3101-1955, Qty 1, SWITCH-TOGGLE SUBMIN SPDT .02A 20VAC/DC PC.

Page 8-4. Safety Considerations:
Add NOTE,

> The High Voltage Power Supply, A5, is defeated automatically by A1S2, when the 5518A cover is removed. For adjustments and Servicing purposes, the High Voltage Supply can be re-enabled by setting the TEST-NORM switch, A1S1, to TEST after the 5518A cover is removed.

CHANGE 2 (Continued)

Page 8-C-13:

Change steps d through h to d through i.

Add step d to paragraph 8-C-39:

"d. Enable the laser high voltage section by setting the TEST-NORMAL switch on Connector board A1 to TEST.

Change step i to read as follows:

i. Disconnect the test equipment set set HEATER jumper JMP7 to NORM. Set TEST-NORM switch to NORM and replace the 5518A cover.

Page 8-C-15, 5518A Laser Head:

Add WARNING and NOTE following paragraph 8-C-43:

WARNING

WITH THE 5518A COVER REMOVED AND A1S2 SET TO THE TEST POSITION, UP TO 12 KILOVOLTS WILL BE PRESENT AT THE OUTPUT OF THE HIGH VOLTAGE POWER SUPPLY ASSEMBLY A6.

NOTE

After servicing the 5518A, be sure to set A1S2 to the NORM position, otherwise power will be disconnected. See Figure 7-3.

Page 8-C-16.

Change paragraph 8-C-46 step b to read:

b. Remove the cover of the 5518A. Set A1S2 to TEST and verify all boards are seated correctly and all test jumpers on A3 board are to the left (NORM). Turn 5508A power on. Check the following voltages. If any are incorrect see power supply servicing in A3 servicing procedures (Paragraph 8-C-129):

Add warning under step b:

WARNING

WITH A1S2 IN THE TEST POSITION THE 5518A HIGH VOLTAGE POWER SUPPLY A5 IS ENABLED.

Page 8-C-19. 5518A Laser High Voltage Section Circuit Theory:

Paragraph 8-C-51:

Add "Switch S1 is a safety interlock which removes power from the laser power supply when the 5518A cover is removed. Switch S2 defeats the interlock so the laser can be serviced. S1 and S2 are wired in such a way that the interlock must be enabled before replacing the cover."

Paragraph 8-C-53:

Add "Check switches S1 and S2" in last line.

Figure 8-C-11. Laser Assembly Wiring:

Add Switches S1 and S2.

Page 8-C-20. High Voltage Power Supply Troubleshooting:

Add the following after "NO LASER LIGHT is emitted." in paragraph 8-C-58, step a: "First check that A1S2 is set to 'NORM'" when the cover is on or "TEST" when the cover is off.

Page 8-C-28, Digital Troubleshooting:

Add "Defeat high voltage interlock by setting A1S2 to TEST" to beginning of paragraph 8-C-119(a).

CHANGE 2 (Continued)

Page 8-C-31, Photodiode & Amplifier Troubleshooting/ Liquid Crystal Troubleshooting:
Add "Defeat high voltage interlock by setting A1S2 to TEST" to beginning of paragraph 8-C-120(a).
Add "Set A1S2 to TEST" to the beginning of paragraph 8-C-123(a).

Page 8-C-37, Fig 8-C-12. 5518A A1 Connector Board 05518-60001 Schematic Diagram:
Add S1 (pushbutton) to the left of F1 on component locator.
Add S2 (toggle switch) above R1 on component locator.
Add S1 and S2 to schematic diagram as shown in Figure 7-4.

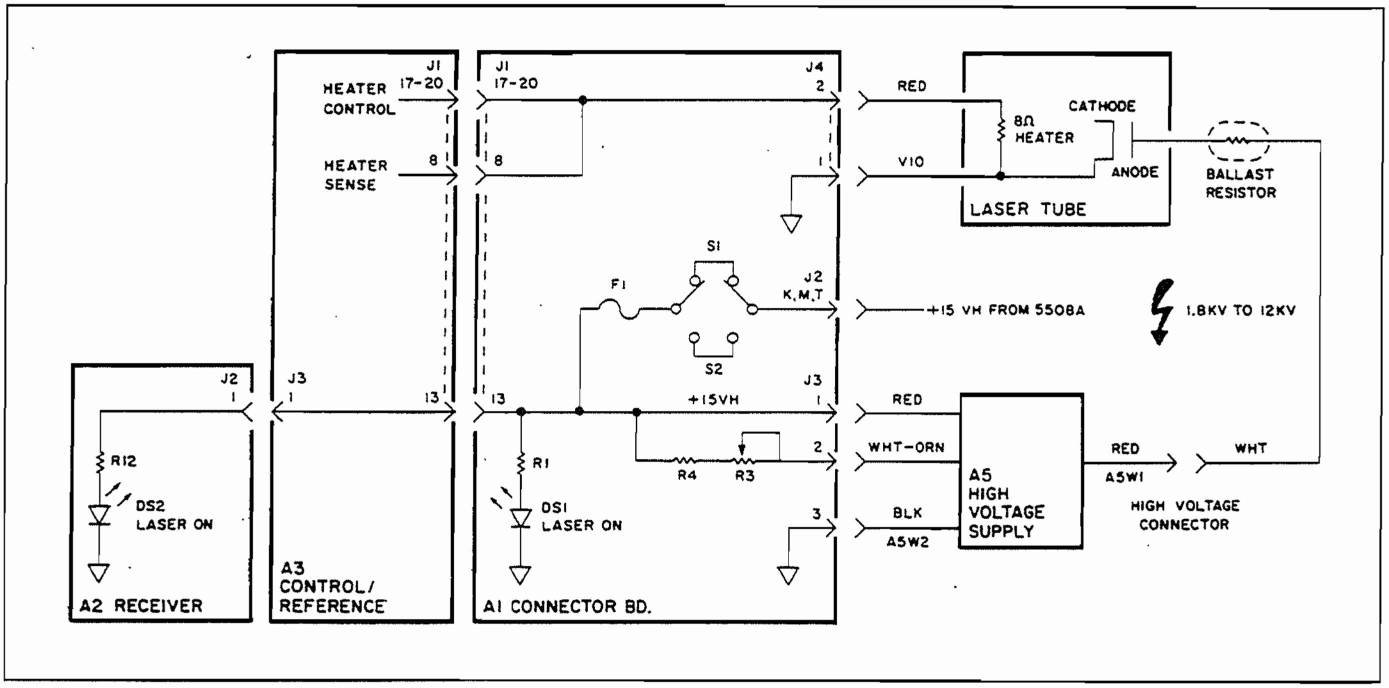

HEATER CONTROL
J1 17-20
HEATER SENSE
8
J1 17-20
8
J4 2
1
RED
V10
8Ω HEATER
CATHODE
ANODE
LASER TUBE
BALLAST RESISTOR
S1
F1
J2 K,M,T
+15 VH FROM 5508A
1.8KV TO 12KV
S2
J2 1
J3 1
13
13
+15VH
J3 1
2
3
R12
DS2 LASER ON
A2 RECEIVER
A3 CONTROL/ REFERENCE
R1
DS1 LASER ON
R4
R3
A1 CONNECTOR BD.
RED
WHT-ORN
BLK
A5W2
A5 HIGH VOLTAGE SUPPLY
RED
A5W1
WHT
HIGH VOLTAGE CONNECTOR

Figure 7-4. Laser Assembly Wiring

CHANGE 3 (5518A Serial Numbers above 3020A03374)

Page 6-39, Figure 6-9. 5518A Laser Head Exploded View:

NOTE:

5518A Laser Heads with Serial Number 3020A03374 & above may contain two spacers (part number 0380-0019) between MP17 Turret Base and MP25 Straightness mount.

CHANGE 4 (5518A Series 2948A)

To backdate from Series 3020A to Series 2948A, make the following changes:

Page 1-3. General Information
Change 5518A SERIES from 3020A to 2948A in Table 1-1.

Page 6-39, Figure 6-9. 5518A Laser Head Exploded View:
Change MP12 COVER from 05518-00012 to 05518-00011.
Change MP13 BASE-MACHINED from 05518-20321 to 05518-20302.

CHANGE 5 (5518A Series 2520A)

To backdate the 5518A from 2532A02139 to Series 2520A, make the following changes:

Page 1-4, Table 1-2. Specifications And Supplemental Characteristics:
Delete the following specification for the HP 5518A Laser Head:
Split Frequency: 1.7 - 2.4 MHz

Page 1-9, Table 1-2. Specifications And Supplemental Characteristics (Cont'd):
Linear Distance and Velocity Measurements:
Change Maximum Velocity to read as follows: ±18000 mm/min (±720 in/min)

CHANGE 6 (5518A SERIAL PREFIX 2520A)

5518A Laser Heads with Serial Prefix 2520A differ from later versions as follows:

The radiator fins on top of the laser assembly (Item 22, Figure 6-9) and the hole in the cover (Item 12, Figure 6-9) have been removed from later instruments.

To backdate this manual to be applicable to 5518A instruments with Serial Prefix 2520A, make the following changes:

Page 1-3, Table 1-1. 5528A Equipment and Manual Serial Prefix Effectivity:
Change 5518A Laser Head serial prefix from 2532A to 2520A.

Page 6-39, Figure 6-9, 5518A Laser Head Exploded View:
Change Item 12 HP Part Number (Cover) from 05518-00011 to 05518-00008. The older laser head cover (i.e., 05518-00008) has a rectangular hole to accommodate the laser tube fins found on the older laser tubes.

Add the following to table found on page 6-39:
Item 46, Qty 1, GASKET (EMI), HP Part Number 8160-0398.

Page 8-C-18, Figure 8-C-10. 5518A Assembly Designations:
Replace Figure 8-C-10 with Figure 7-5.

CHANGE 7 (5518A SERIAL PREFIX 2502A)

5518A Laser Heads with Serial Prefix 2502A differ from later versions as follows:

In later versions, four screws (Item 36, Figure 6-9) have been replaced and four washers added (Item 36a, Figure 6-9).

To backdate this manual to be applicable to 5518A instruments with Serial Prefix 2502A, make the following changes:

Page 1-3, Table 1-1. 5528A Equipment and Manual Serial Prefix Effectivity:
Change 5518A Laser Head serial prefix from 2520A to 2502A.

Page 6-39, Figure 6-9, 5518A Laser Head Exploded View:
Change Item 36 HP Part Number from 0515-0426 to 0515-0332. Modify part description to read "M3 X 0.5 X 6.0 FHMS BK".
Delete Item 36a.

Reference Designator	Description
A1	Connector Board
A2	Receiver Board
A3	Controller/Reference Board
A4	Sampler Board
A5	High Voltage Power Supply
A6	Laser Assembly
A7	Sampler Assembly
A8	Straightness Mount

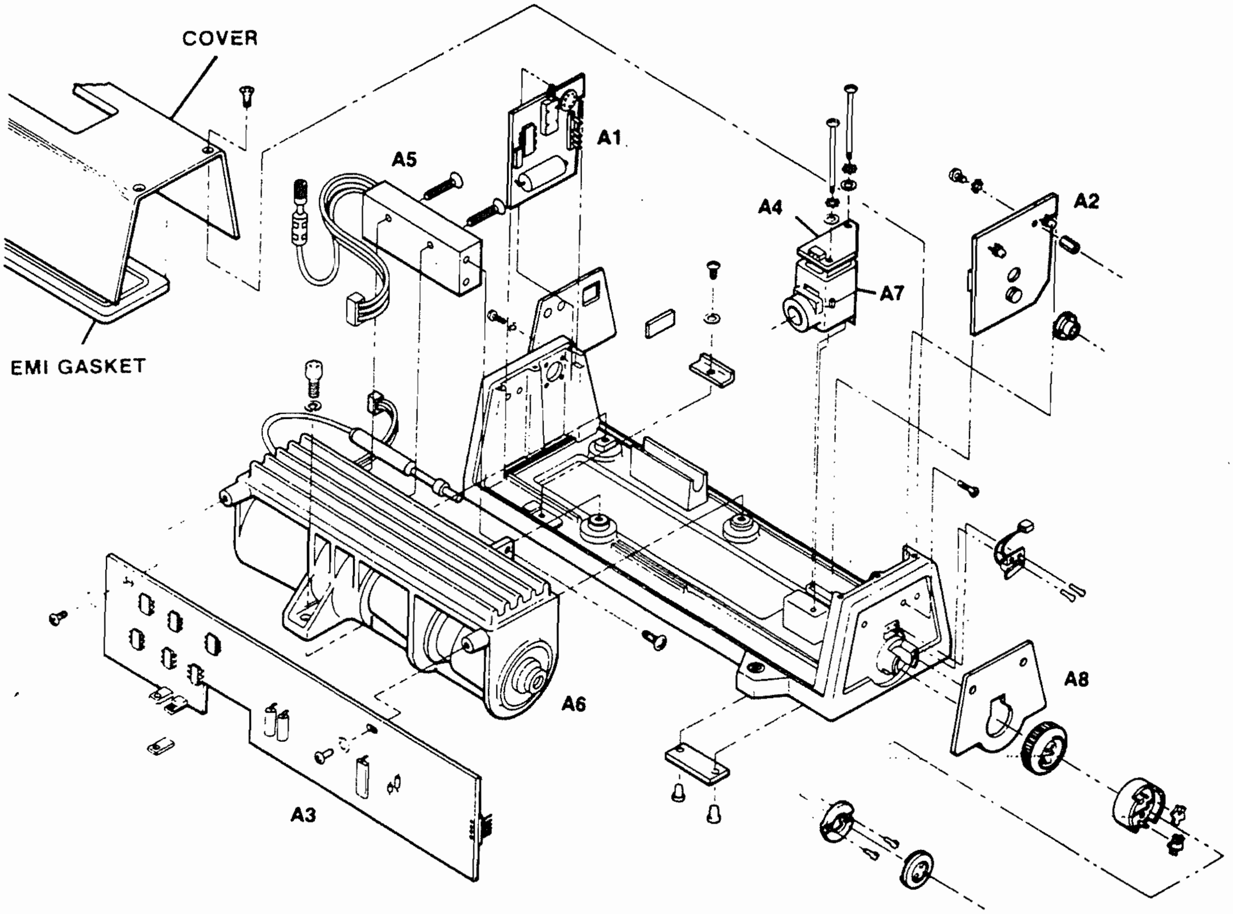

COVER
EMI GASKET
A5
A1
A4
A7
A2
A6
A3
A8

Figure 7-5. 5518A Assembly Designations

CHANGE 8 (5518A SERIAL PREFIX 2408A)

5518A Laser Heads with Serial Prefix 2408A differ from later versions as follows:

Later versions of the 5518A laser assembly (Item 22, Figure 6-9) have the part number 05517-60801.

To backdate this manual to be applicable to 5518A instruments with Serial Prefix 2408A, make the following changes:

Page 1-3, Table 1-1. 5528A Equipment and Manual Serial Prefix Effectivity:
Change 5518A Laser Head serial prefix from 2502A to 2408A.

Page 6-39, Figure 6-9, 5518A Laser Head Exploded View:
Change Item 22 HP Part Number from 05517-60801 to 05518-60801.

CHANGE 9 (5518A SERIAL PREFIX 2332A)

5518A Laser Heads with Serial Prefix 2332A differ from later versions as follows:

a. Ferrite beads A3L5 and A3L6 are not installed in later versions.*

b. Resistor A3R44 value has been changed in later versions.

c. Resistor A3R52 has been added to later versions.

d. Item 22 laser assembly part number is 05518-60801 in later versions.

e. Flat washer (Item 53, Figure 6-9) has been added to later versions. *Components A3L5, A3L6, A3R44, and A3R42 are located in Block L of Figure 8-C-14.

To backdate this manual to be applicable to 5518A instruments with Serial Prefix 2332A, make the following changes:

Page 1-3, Table 1-1. 5528A Equipment and Manual Serial Prefix Effectivity:
Change 5518A Laser Head serial prefix from 2408A to 2332A.

Pages 6-15 and 6-16, Table 6-4. 5518A P.C. Board Assemblies Replaceable Parts:
Delete A3C31 and A3R52.
Add A3L5 and A3L6, HP Part Number 9170-0029, CD 3, Qty 2, CORE-SHIELDING BEAD, Mfr Code 28480, Mfr Part Number 9170-0029.
Change A3R44 HP Part Number from 0757-0438 to 0698-3154, CD 0, Qty 1, RESISTOR 4.22K 1%.125W F TC=0±100, Mfr Code 24546, Mfr Part Number C4-1/8-TO-4221-F.

Page 6-39, Figure 6-9, 5518A Laser Head Exploded View:
Delete Item 53.
Change Item 22 HP Part Number from "05518-60801" to 05518-60301.
Delete footnote.

Page 8-C-41, Figure 8-C-14, A3 5518A Controller/Reference Board 05518-60003 and A4 Sample Board 05518-60004.

Replace Block L with Figure 7-3.
Change A3 board series number located at upper left comer of the schematic, from 2408 to 2328,
Delete capacitor A3C31 and resistor A3R52 from component locator.
Change "Reference Designations" table as follows:
C1-31 to C1-30
R48-R52 to R48-R51

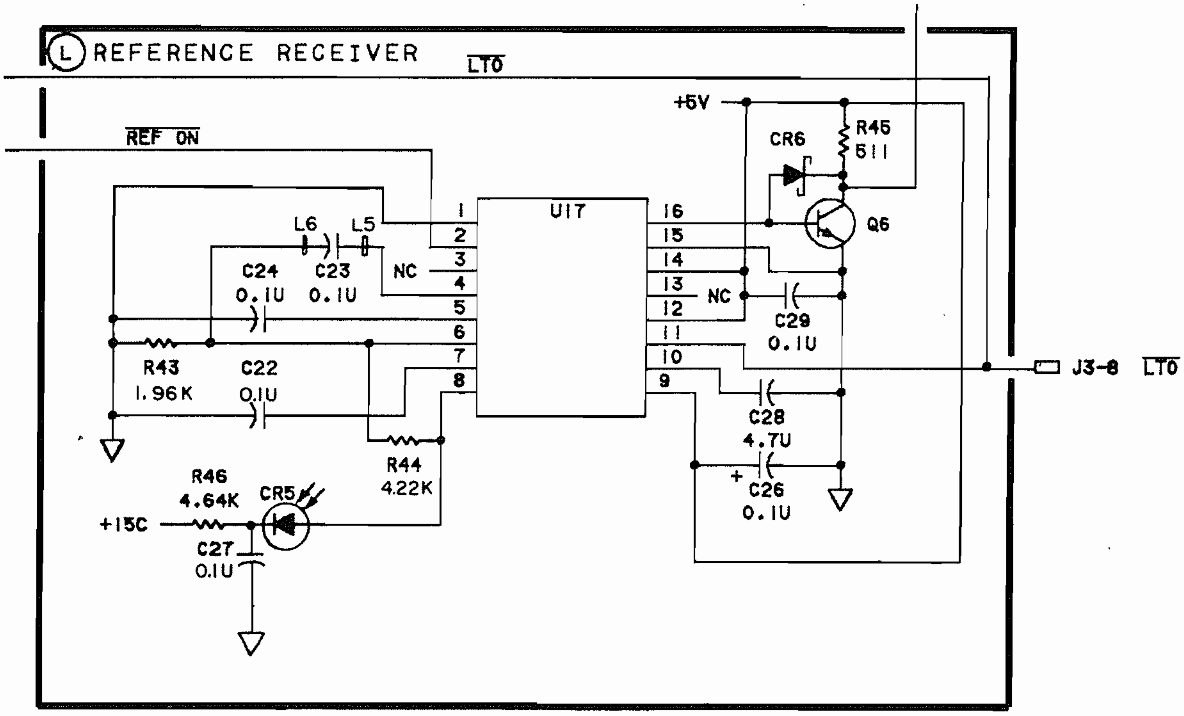

L
REFERENCE RECEIVER
LTO
REF ON
+5V
CR6
R45
511
U17
1
2
3
4
5
6
7
8
16
15
14
13
12
11
10
9
L6
L5
C24
0.1U
C23
0.1U
NC
Q6
NC
C29
0.1U
J3-8
LTO
R43
1.96K
C22
0.1U
C28
4.7U
R44
4.22K
R46
4.64K
CR5
+15C
C27
0.1U
+
C26
0.1U

Figure 7-6. Reference Receiver [Block L (Part of Figure 8-C-14)]

CHANGE 10 (5518A SERIAL PREFIX 2328A)

5518A Laser Heads with Serial Prefix 2328A differ from later versions as follows:

The part numbers for the leveling foot and lock nut were changed. For Series 2328A and below, these had 10753- part numbers and were shipped with the tripod mounting plate. After 2328A, the leveling foot and lock nut have 05518- part numbers and are shipped with the 5518A.

To backdate this manual to be applicable to 5518A instruments with Serial Prefix 2328A and below, make the following changes:

Page 6-46, Part of Figure 6-12, 10753A Tripod, HP Replaceable Parts:
Change Item 1 to HP Part Number 10753-20010 (P/0 Part No. 10753-60001).
Change Item 2 to HP Part Number 10753-20011 (P/0 Part No. 10753-60011).

CHANGE 11 (SERIAL PREFIX 2308A)

5518A Laser Heads with Serial Prefix 2308A differ from later versions as follows:

a. A3L5 and A3L6 were not installed.
b. A3R6 was 4.64M.
c. A3R17 was 681k.

To backdate this manual to be applicable to 5518A instruments with Serial Prefix 2308A, make the following changes:

Pages 6-15 and 6-16, Table 6-4:
Delete A3L5 and A3L6.
Change A3R6 to 0699-0071, QTY 4, RESISTOR 4.64M 1%.125W F TC=0±100, Mfr Code 28480, Mfr Part Number 0699-0071.
Change A3R17 to 0698-8825, QTY 1, RESISTOR 681K 1%.125W F TC=0±100, Mfr Code 28480, Mfr Part Number 0698-8825.

Page 8-C-41, Figure 8-C-14:
Delete A3L5 and A3L6.
Change A4R6 to 4.64M
Change A3R17 to 681k.

CHANGE 12 (5518 SERIAL PREFIX 2236A)

5518 Laser Heads with instrument Serial Prefix 2236A differ from later versions as follows:

Blocks K and L of Figure 8-C-14 had several resistor and capacitor changes.

To backdate this manual to be applicable to 5518A instruments with Serial Prefix 2236A, make the following changes:

Page 6-15, Table 6-4, 5518A PC Board Assemblies Replaceable Parts:
Add A3C25,0160-4554, CAPACITOR-FXD 0.01 UF +20% 50 VDC CER, Mfr Code 28480, Mfr Part Number 0160-4554.
Change A3C22, A3C26, and A3C27 to 0160-4554, CAPACITOR-FXD 0.01 UF+20%50 VDCCER, Mfr Code 28480, Mfr Part Number 0160-4554.

Page 6-16, Table 6-4, PC Board Assemblies Replaceable Parts:
Add A3R42, 0757-0416, RESISTOR 511 1% 0.125W F TC=0±100, Mfr Code 24546, Mfr Part Number C4-1/8-TO-511R-F.
Change A3R43 to 0757-1094, RESISTOR 1.47K 1% 0.125W F TC=0±100, Mfr Code 24546, Mfr Part Number C4-1/8-TO-1471-F.
Change A3R44 to 0757-0442, RESISTOR 10K 1% 0.125W TC=0±100, Mfr Code 24546, Mfr Part Number C4-1/8-TO-1002-F.
Add A3R47, 0757-0461, RESISTOR 68.1K 1% 0.125W F TC=0±100, Mfr Code 24546, Mfr Part Number C4-1/8-TO-6812-F.

Page 8-C-41, Figure 8-C-14, 5518A A3 Schematic Diagram:
Replace Blocks K and L with Figure 7-7.
Change series number of A3 to 2236.

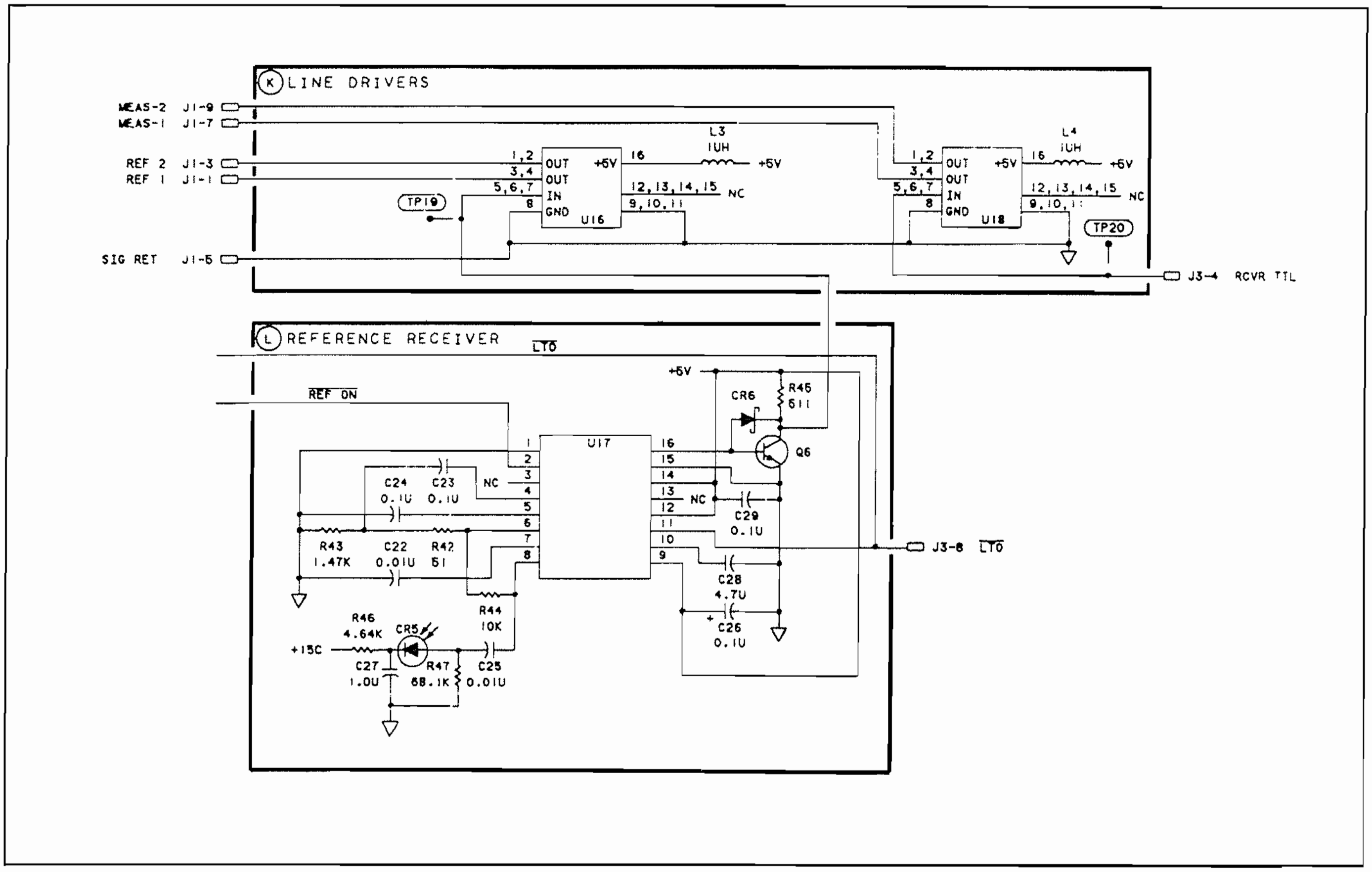

K LINE DRIVERS
MEAS-2 J1-9
MEAS-1 J1-7
REF 2 J1-3
REF 1 J1-1
SIG RET J1-5
TP19
1,2
3,4
5,6,7
8
OUT
OUT
IN
GND
+5V
U16
16
12,13,14,15
9,10,11
NC
L3
1UH
+5V
1,2
3,4
5,6,7
8
OUT
OUT
IN
GND
+5V
U18
16
12,13,14,15
9,10,11
NC
L4
1UH
+5V
TP20
J3-4 RCVR TTL
L REFERENCE RECEIVER
$\overline{\text{LTO}}$
$\overline{\text{REF ON}}$
+5V
CR6
R45
511
Q6
U17
1
2
3
4
5
6
7
8
16
15
14
13
12
11
10
9
NC
NC
C24
0.1U
C23
0.1U
R43
1.47K
C22
0.01U
R42
51
C29
0.1U
C28
4.7U
C26
0.1U
R44
10K
R46
4.64K
CR5
+15C
C27
1.0U
R47
68.1K
C25
0.01U
J3-8 $\overline{\text{LTO}}$

Figure 7-7. 5518A A3 Schematic (Series 2236)

CHANGE 13 (5518A SERIAL PREFIX 2220A)

5518A Laser Heads with instrument Serial Prefix 2220A differ from later versions as follows:

a. Had a mini-key cap installed on switch S1 located on the A1 Connector Board 05518-60001.

b. Used 2/64" RFI tabs on both ends of the cover.

c. Used longer screws and spacers for securing transistors to the A3 Controller/Reference Board 05518-

d. A3R47 was not used.

e. A3C25 was not used and a jumper was installed in its place.

To backdate this manual to be applicable to 5518A instruments with Serial Prefix 2220A, make the following changes:

Page 6-39, Figure 6-9:
Add Item 48, Qty 1, Mini-key Cap, 0370-0604 to the exploded view. On Item 21, indicate Item 48 is installed on the interlock switch at the top center of the board.
Change the part number of Item 34 to 0515-0408. Change screw length to 12.0"

Page 6-15, Table 6-4:
Delete A3C25 and listing.

CHANGE 13 (5518A SERIAL PREFIX 2220A) (Continued)

Page 6-17, Table 6-4:

Under "Miscellaneous A3 Parts", add jumper Wire, HP Part Number 8159-0005. This is the jumper wire replacing C25, Delete A3R47 and listing.

Under Miscellaneous A3 Parts, add Spacer, 10 × 12 mm, 18 Gauge, Qty 2.

Page 6-39, Figure 6-9:

On Exploded View, indicate the spacers are installed under Item 30 and under the right-most transistor at the bottom of the board.

Page 8-C-41, Figure 8-C-14, A3 Board:

At top left of board, change the A3 series number to 2216. Add Series 2216 for A4.

At lower right of schematic in Block L, replace A3C25 with a straight jumper. Delete A3R47.

Page 8-C-15, Figure 8-C-9, A1 Board (Photo):

Change series number to 2216.

Page 8-C-37, Figure 8-C-12, A1 Board Schematic:

Change series numbers to 2216.

Table 7-3. 10751A/B Manual Backdating

If Your Instrument Has Serial Prefix or Serial Number	Make Backdating Change
2308A	1
2220A, 2216A	1,2

CHANGE 1 (10751A/B SERIAL PREFIX 2308A)

10751A/B Air Sensors with Serial Prefix 2308A differ from later versions as follows:

To backdate this manual to be applicable to 10751 instruments with Serial Prefix 2308A, make the following changes:

Page 1-3, Table 1-1. 5528A Equipment and Manual Serial Prefix Effectivity:
Change 10751A/B Air Sensor serial prefix from 2452A to 2308A.

Page 6-18, Table 6-5, 10751-60001 P.C. Board Assembly Replaceable Parts:
Change A1C6 and A1C7 from 0180-3573 to 0180-0374, CD 3, Qty 2, CAPACITOR 10UF±10% 20VDC TA, Mfr Code 56289, Mfr Part Number 150D106X9020B2. Due to its 20VDC rating, it is not recommended for use.
Change A1 board series from 2452 to 2308.

Page 8-D-9, Figure 8-D-4, 10751A/B Air Sensor:
Change A1 board series prefix, located at the upper left hand of schematic diagram, from 2452 to 2308.

CHANGE 2 (10751A/B SERIAL PREFIX 2220A AND 2216A)

10751A/B Air Sensors with instrument Serial Prefix 2220A or 2216A differ from later versions as follows:

Capacitor A1C24 was not installed on the 10751-60001 board.

To backdate this manual to be applicable to 10751A/B instruments with Serial Prefix 2220A or 2216A, make the following changes:

Page 6-18, Table 6-5, 10751-60001 Replaceable Parts:
Delete A1C24.

Page 8-D-9, Figure 8-D-4, 10751A/B Air Sensor Schematic Diagram:
Delete A1C24.

Table 7-4. 10757A/B/C Manual Backdating

If Your Instrument Has Serial Prefix or Serial Number	Make Backdating Change
2416A	NO CHANGES REQUIRED (see explanation below)

The current serial prefix for the 10757A/B/C is either 2416A, or the serial prefix specified in the "Manual Updating Changes" sheets that will accompany a manual if changes to the product have occurred (see paragraph 7-4, this manual). Since the 10757A/B/C's introduction, no changes have been instituted. The product that the 10757A/B/C replaced, the 10752A/B/C, had a serial prefix of 2220A when obsoleted. The following changes will therefore backdate this manual to reflect a system equipped with 10752A/B/C instead of a 10757A/B/C.

All Pages:

Throughout this manual, indicate that the 10752A/B/C is used in place of the 10757A/B/C. Please note that the 10757A/B/C provides improved accuracy for temperature compensation.

Page 1-5, Table 1-2, Specifications and Supplemental Characteristics:
Replace "HP 10757A/B/C MATERIAL TEMPERATURE SENSOR" with the following:

HP 10752A/B/C MATERIAL TEMPERATURE SENSOR

Description: The 10752A/B/C contains an integrated circuit-type temperature sensor mounted in a remote oil immersible "button" with a magnetic base. A cable is attached to the button for connection to the HP 5508A Measurement Display. Up to three Material Temperature Sensors can be used in the system.

Cable Lengths:
10752A: 5 m (16 feet)
10752B: 15 m (49 feet)
10752C: 25 m (82 feet)

Maximum Sensor Error:
(With 12 month calibration interval)

Over Temperature Range 15-25°C: ±0.35°C
Over Temperature Range 0-40°C: ±0.80°C

Dimensions: (Excluding cable) 32 mm diameter x 15 mm height

Weight:
10752A: 160 grams
10752B: 310 grams
10752C: 450 grams

Page 3-15, Paragraph 3-20:
Replace paragraph 3-20 with the following:

3-20. The RANGE of the 10752A/B/C is 0 to 50° C(32 to 122° F).When sensors reach temperatures outside of this range, appropriate error messages are displayed by the 5508A. See paragraph 3-8 (ERROR MESSAGES) for explanation of these messages. The same error messages are used when temperature signal errors occur due to hardware failures.

Pages 4-15 through 4-19, Paragraphs 4-45 through 4-51:
Replace procedures found in paragraphs 4-45 through 4-51 with "10752A/B/C CALIBRATION PROCEDURES" found in Table 7-6.

Page 6-21, Table 6-7, 10757A/B/C Replaceable Parts:
Replace Table 6-7 with Table 7-5.

Table 7-5. 10752A/B/C Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	10752-60001	**3**	**1**	**AMPLIFIER ASSEMBLY**	**28480**	**10752-60001**
C1	0160-4554	7		CAPACITOR-FXD .01UF ±20% 5OVDC CER	28480	0160-4554
C2	0160-3829	7	1	CAPACITOR-FXD .47UF ±10% SOVOC	28480	0160-3829
C3	0160-4557	0		CAPACITOR-FXD 1UF ±20% SOVDC CER	16299	CAC04X7P104M050A
C4	0160-4557	0		CAPACITOR-FXD 1UF ±20% SOVDC CER	16299	CAC04X7RI04MO50A
R1	2100-3154	7	1	RESISTOR-TRMR IK 10% C SIDE-ADJ 17-TRN	02111	43PI02
R2	0699-0811	2		RESISTOR 33K .1% .125W F TC=O±5	28480	0699-0811
R3	0698-3158	4		RESISTOR 23.7K 1% .125U F TC-0±100	24546	C4-1/8-TO-2372-F
U1	1826-0543	9		IC OP AMP LOW-DRIFT TO-99 PKG	06665	OP-07CJ
				FOR 10752 MISCELLANEOUS AND CHASSIS PARTS, SEE FIGURE 7-6.		

Page 6-45, Figure 6-11, 10752A/B/C Exploded View:
Replace Figure 6-11 with Figure 7-8.

Page 8-A-18, Paragraph 8-A-90:
Change "10757A/B/C" to read "10752A/B/C",and ±15V current requirements from 20 to 10 mA.

Page 8-E-1, Section VIII-E, 10757A/B/C Material Temperature Sensor:
Replace Section VIII-E with the contents of Table 7-8.

Page 8-E-5, Figure 8-E-2, 10757A/B/C Material Temperature Sensor Schematic Diagram:
Replace Figure 8-E-2 with Figure 7-9.

Table 7-6. 10752A/B/C Calibration Procedures

10752A/B/C CALIBRATION PROCEDURES

Due to the complexity of the calibration procedures and test equipment required, it is recommended that the 10752A/B/C be returned to Hewlett-Packard for periodic calibration.

The 10752A/B/C temperature circuitry requires a 12 month calibration cycle. Also, calibration should be performed after repair is made to any of the 10752A/B/C circuits.

Equipment Required. Refer to Table 1-4 in Section I for a list of test equipment required for the 10752A/B/C calibration procedure. In addition, the procedures require the 5508A Measurement Display and an HP 3456A Digital Voltmeter.

WARNING

MAINTENANCE DESCRIBED HEREIN IS PERFORMED WITH POWER SUPPLIED TO THE INSTRUMENT, AND PROTECTIVE COVERS REMOVED. 100 VOLTS TO 240 VOLTS AC MAY BE PRESENT IN THE 5508A EVEN WHEN THE FRONT PANEL POWER SWITCH IS SET TO OFF. MAINTENANCE SHOULD BE PERFORMED ONLY BY SERVICE-TRAINED PERSONNEL WHO ARE AWARE OF THE HAZARDS INVOLVED (FOR EXAMPLE, FIRE AND ELECTRIC SHOCK). WHERE MAINTENANCE CAN BE PERFORMED WITHOUT POWER APPLIED, THE POWER CORD SHOULD BE REMOVED.

CAUTION

The 10752A/B/C circuitry is susceptible to damage from electrostatic discharge, therefore use an anti-static work station and ground straps when handling printed circuit assemblies during assembly or disassembly.

10752A/B/C calibration is performed and the temperature transducer immersed in a temperature controlled bath at 20°C±1°C.

NOTE

The 10752A/B/C temperature sensor should be immersed ONLY in dielectric liquid, Flourinet FC-40 or equivalent.

The equipment in Table 1-4 should be configured to form the system depicted in Figure 4-1.

a. On the side of the 10752A/B/C, using a small flat-bladed screwdriver, press in on the tabs to remove the 10752A/B/C case.

b. Remove the 10752A/B/C cover noting how the printed circuit board is mounted.

c. Inspect cable and connectors for damage.

d. Secure 10752-60001 printed circuit board such that power can be applied and potentiometer A1R1 can be adjusted.

e. Immerse the sensor head into the bath in close proximity to the quartz thermometer probe without resting either on the inside of the bath housing.

f. Connect 10752A/B/C cable assembly to 5508A rear panel connector marked MATERIAL TEMPERATURE 1.

g. On the 5508A rear panel, set ENGLISH/METRIC switch to METRIC.

h. Plug 5508A into AC outlet and set the LINE switch to ON.

i. Wait for 10 minutes until 5508A goes through its warm-up countdown sequence and the display flashes LASr FAIL. If the 5508A fails its self test or the warm-up countdown does not end with LASr FAIL, check setup and see 5528A Block Diagram and System Troubleshooting found in Section VIII.

j. Connect the positive lead of the DVM to test point A3TP40, marked +10VR, and the negative lead to test point A3TP39, marked AG (for Analog Ground), on the 5508A A3 board.

Table 7-6. 10752A/B/C Calibration Procedures (Continued)

k. The measured value should be +10V±10 millivolts. If not, check setup and see +10 Vref Troubleshooting in Section VIII. Write down the value of +10 Vref for use in step n.

l. Monitor the quartz thermometer to be sure that the bath temperature is stable at 20°C±1°C to within 0.03°C for a 1 minute period.

m. Connect floating negative terminal of DVM to test point TP39 [AG (Analog Ground) on 5508A A3 board] and positive terminal of DVM to pin 2 of A3R56.

n. Note the reading of the quartz thermometer (in °C) and calculate the adjustment voltage, V, as follows:

$$V = 0.84956 - (0.0335 \times T) + dV$$

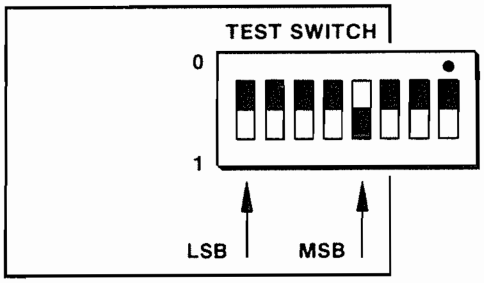
where T is the reading of the quartz thermometer and dV = +10 Vref -10.

o. Adjust 10752A/B/C A1R1 such that the DVM reading equals V±250 microvolts.

p. The accuracy of the 10752A/B/C temperature measurement can be checked using the quartz thermometer and bath temperature within the operating range of the 10752A/B/C (0 to 40°C).

Procedure:

1. Perform the 5508A Calibration Procedures, paragraphs 4-27 through 4-35.
2. Set 5508A Test Switches A2S3 to 0001 0000 and toggle the Master Reset switch A2S2.



The 5508A display should read 0.0000 mm. If not, check A2S3 setting and see 5528A Block Diagram and System Troubleshooting.

3. On 5508A, press MATL TEMP twice on 5508A front panel to display

   1XX.XXC

   where XX.XX is the temperature measured by the 10752A/B/C.

4. The bath temperature can now be adjusted to various temperatures within the range of 0 to 40°C in order to verify temperature measurement specifications of the 10752A/B/C. The reading of the quartz thermometer should be allowed to stabilize at each selected temperature to within ±0.03°C for 1 minute before comparing the reading to that on the 5508A display.

   If any reading within the operating range indicates measurement error outside the accuracy specifications of the 10752A/B/C, the Temperature Sensor Assembly should be replaced and the calibration procedure repeated.

q. Turn 5508A AC power OFF.

r. Remove 10752A/B/C temperature sensor from the bath and allow to dry.

s. Reassemble 10752A/B/C.

Table 7-6. 10752A/B/C Calibration Procedures (Continued)

Table 7-7. Test Record

Test or Calibration	Date/Entry	Date/Entry
1. 5518A Laser Power Output Test	________/________	________/________
2. 5518A Receiver Gain Test	________/________	________/________
3. 5508A +10 Vref	________/________	________/________
4. CAL A (decimal)	________/________	________/________
5. 5508A +0.5 Vref	________/________	________/________
6. CAL B (decimal)	________/________	________/________
7. 10751A/B Calibration	________/________	________/________
8. 10752A/B/C Calibration	________/________	________/________

Table 7-8. 10752A/B/C Material Temperature Sensor Circuit Theory and Troubleshooting

10752A/B/C MATERIAL TEMPERATURE SENSOR CIRCUIT THEORY

The following paragraphs contain circuit theory and troubleshooting information for the 10752A/B/C.

The schematic diagram for the 10752A/B/C is shown in Figure 7-7. The material temperature measurement is identical to the temperature measurement of the 10751A/B Air Sensor, with exception that the IC transducer is encapsulated in a magnetic mount.

The transducer is an absolute temperature sensor which outputs 1 microampere per degree Kelvin. Operational amplifier U1 provides current to voltage conversion with a transresistance of 33.5k Ohm (33.5k Ohm is approximately R1 minus R2). The input range of the A/D converter in the 5508A Measurement Display is -1V<=Vin<=+10V. +10 Vref is applied to the positive input of U1 to provide the necessary offset. At 25 degrees Centigrade the op-amp, MT, equals 0 Volts and has a slope of 33.5 mV/degree C. Resistor R3 is a bias current compensation resistor. C1 eliminates noise from the temperature signal (MT) which is essentially DC.

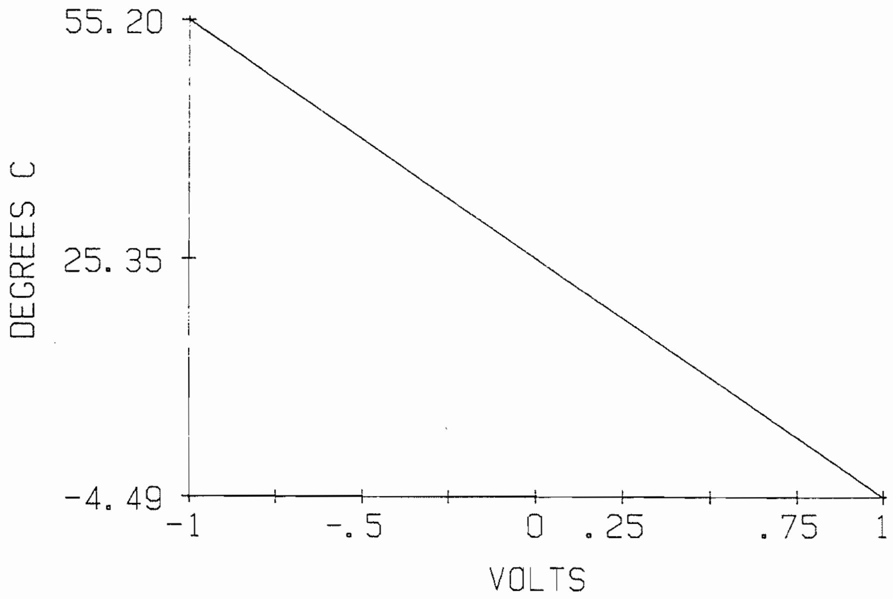


Figure 7-5. Material Temperature Sensor Characteristics

10752A/B/C MATERIAL TEMPERATURE SENSOR TROUBLESHOOTING

The following paragraphs provides a brief troubleshooting procedure for the 10752A/B/C.

a. Verify that +15 V, -15 V and +10 Vref are within tolerances given in Table 8-A-10.

b. Verify +10 Vref on both sides of R3. A voltage drop greater than 1 mV across R3 may indicate a failure of U1. Replace board.

c. Measure voltage on pin 2 of U1. If it is within 1 mV of +10 Vref, verify feedback resistor values before replacing MT1. If pin 2 is outside this 1 mV range, disconnect the temperature sensor board from the main board. If pin 2 is now within 1 mV of +10 Vref, replace the temperature sensor. Otherwise, replace board 10752-60001. U2 output should rise to 10V with the temperature sensor disconnected.

ITEM	QTY	DESCRIPTION	HP PART NUMBER
1	1	LABEL, CALIBRATION	7121-1606
2	1	MTL SENSOR ASSY	(SEE TABLE 1)
3	1	LABEL, SENSOR	7121-1610
4	1	BOARD AY, MTL SENSOR	10752-60001
5	1	CONNECTOR CBL ASSY	8120-3592
6	2	COVER POD	05005-40001
7	1	LABEL, SERIAL	(SEE TABLE 1)

MODEL NO.	MTL SENSOR ASSY PART NO.	SERIAL LABEL PART NO.
10752 A	10752-60301	7121-1607
10752 B	10752-60302	7121-1608
10752 C	10752-60303	7121-1609

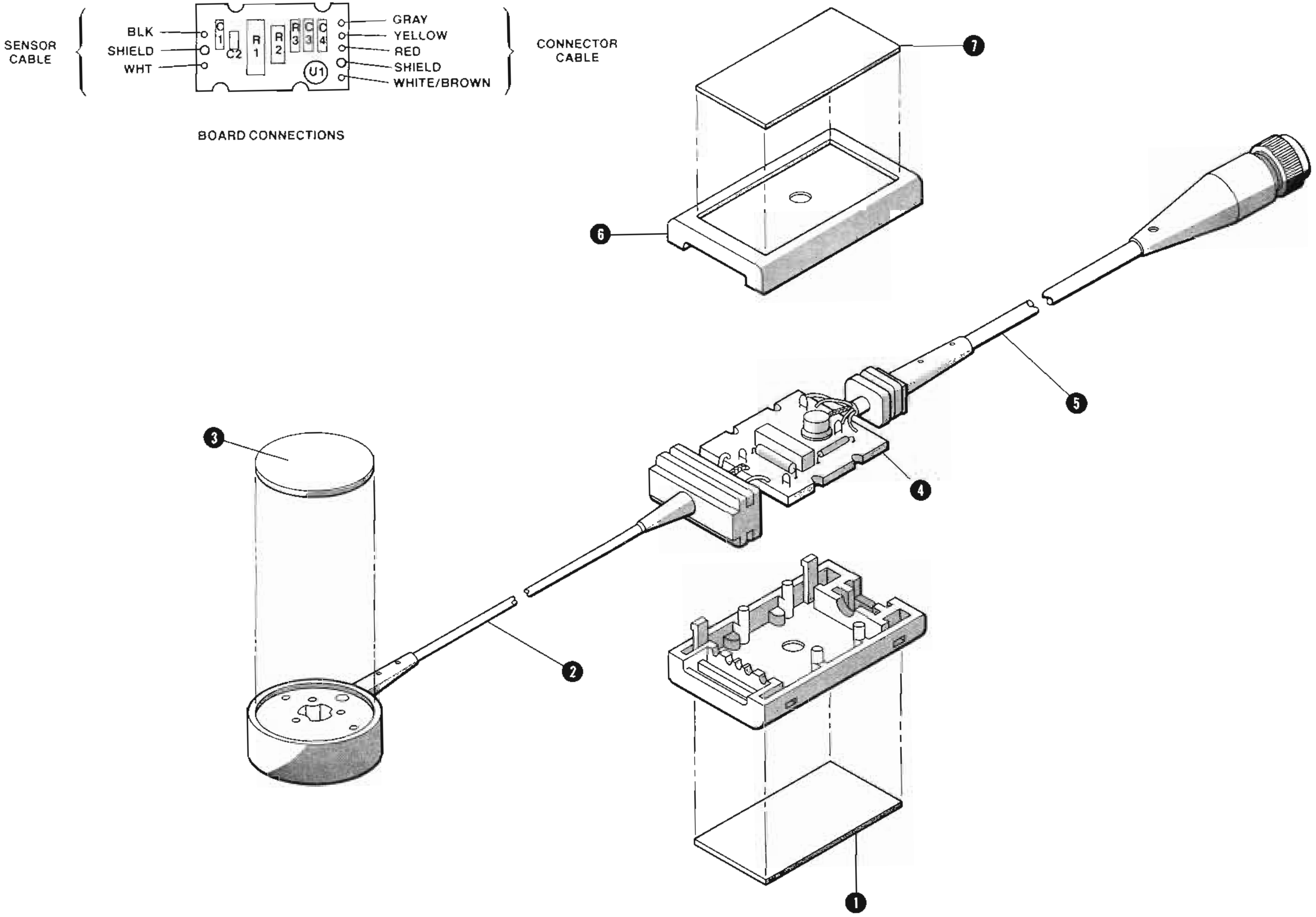

SENSOR CABLE
BLK
SHIELD
WHT
C1
C2
R1
R2
R3
C3
C4
U1
GRAY
YELLOW
RED
SHIELD
WHITE/BROWN
CONNECTOR CABLE
BOARD CONNECTIONS
7
6
5
4
3
2
1

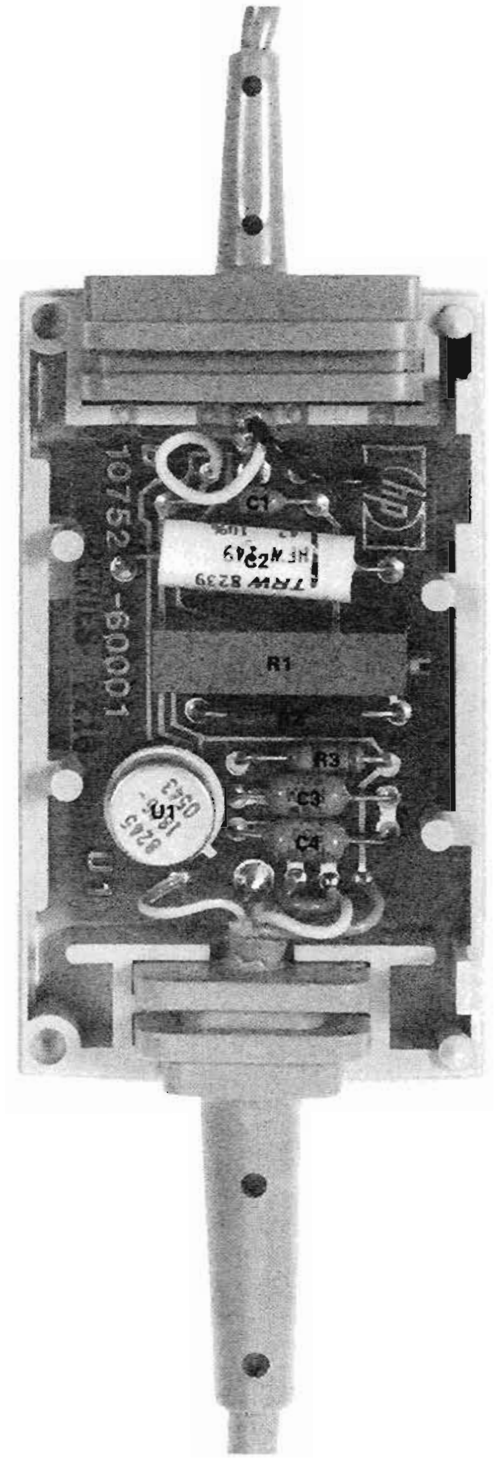
Figure 7-8. 10752A/B/C Exploded View

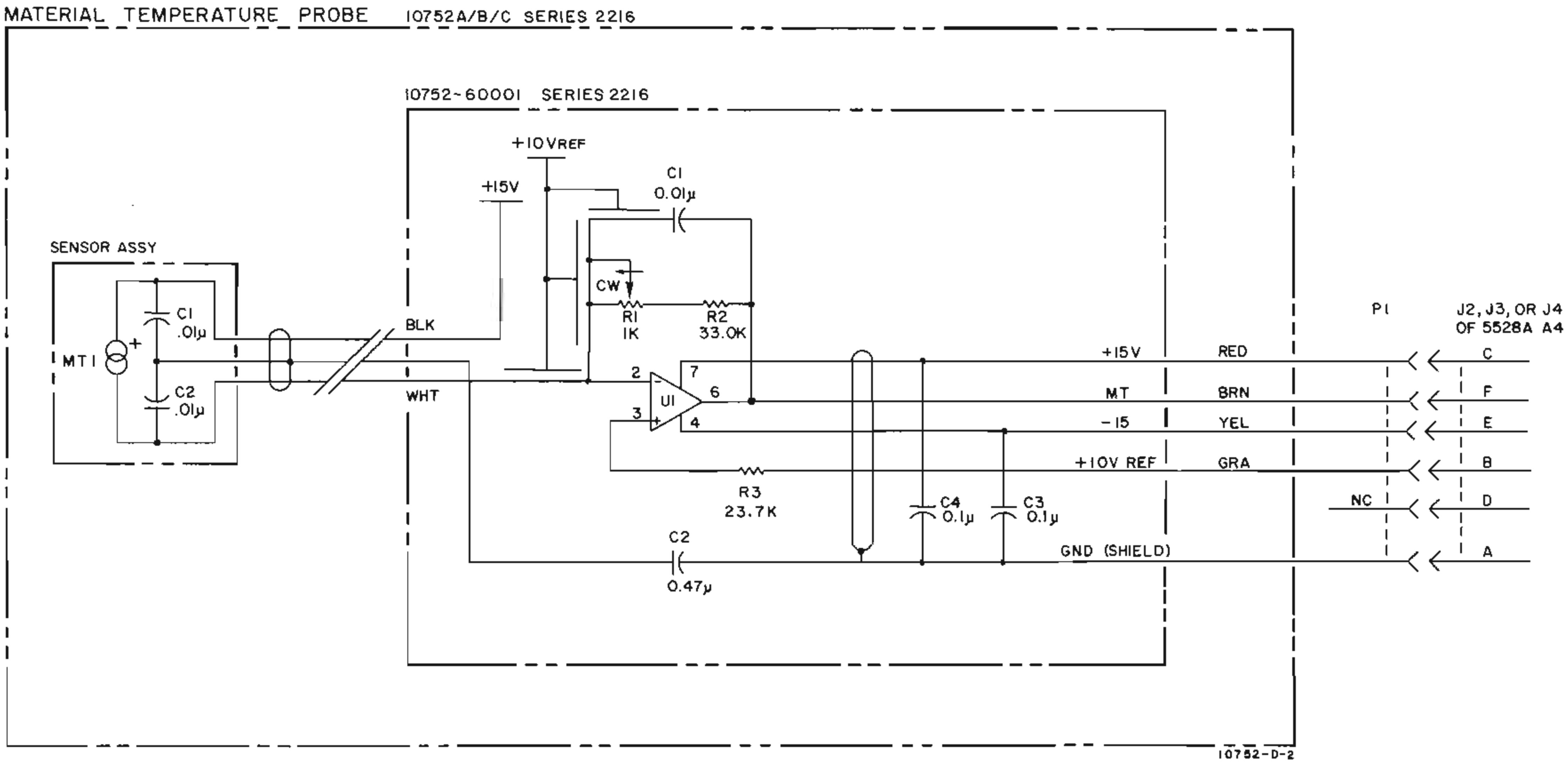
Figure 7-8
10752A/B/C EXPLODED VIEW

(See Page 7-33)

Figure 7-8
10752A/B/C EXPLODED VIEW

(See Page 7-33)


10752-60001
C1
C2
TRW 8239
R1
R2
R3
C3
C4
U1
8265
0543


MATERIAL TEMPERATURE PROBE 10752A/B/C SERIES 2216
10752-60001 SERIES 2216
SENSOR ASSY
MT1
C1 .01µ
C2 .01µ
BLK
WHT
+10VREF
+15V
C1 0.01µ
CW
R1 1K
R2 33.0K
U1
2
3
7
6
4
R3 23.7K
C2 0.47µ
C4 0.1µ
C3 0.1µ
+15V
MT
-15
+10V REF
GND (SHIELD)
RED
BRN
YEL
GRA
P1
NC
J2, J3, OR J4 OF 5528A A4
C
F
E
B
D
A
10752-D-2

NOTES:

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN FARADS;
   INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.

Reference Designations
A1 C1-4 R1-3 U1

TABLE OF ACTIVE ELEMENTS

Reference Desig.	HP Part No.	Mfr. Part No.
U1	1826-0543	OP-07CJ

Figure 7-9. 10752A/B/C A1 Material Temperature Sensor

Figure 7-9
10752A/B/C MATERIAL TEMPERATURE SENSOR

(See Page 7-35)

SECTION VIII
SERVICE

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SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section contains service information for the 5528A Laser Measurement System including safety considerations, theory, block diagrams, schematic diagrams, component locators, and troubleshooting and repair procedures. Useful service information is provided in other sections of the manual, including; operator checks and maintenance in Section III, calibration procedures and performance tests in Section IV, adjustments in Section V, and exploded view illustrations parts lists in Section VI.

8-3. SECTION ORGANIZATION

8-4. Information in this section is organized using dividers with tabs shown in Table 8-1.

Table 8-1. Service Section Organization

Divider	Coverage
VIIIA 5528A	5528A Laser Measurement System System level block diagram and theory, system level troubleshooting
VIIIB 5508A	5508A Measurement Display 5508A overall block diagram and theory, board level theory, schematics, component locators and torubleshooting and repair procedures
VIIIC 5518A	5518A Laser Head 5518A overall block diagram and theory, board level theory, schematics, component locators and troubleshooting and repair procedures
VIIID 10751A/B	10751A/B Air Sensor Board level theory, schematics, component locators, and troubleshooting and repair procedures
VIII-E 10757A/B/C	10757A/B/C Material Temperature Sensor Board level theory, schematics, component locators, and troubleshooting and repair procedures
VIIIF Optics	5528A Optics Theory of operation • Straightness optics • Angular optics Outline drawings, mounting hole dimensions and locations

8-5. THEORY OF OPERATION

8-6. As shown in Table 8-1, the theory of operation is presented at three levels:

a. overall system block diagram theory.

b. instrument block diagram theory, provided for the 5508A and 5518A.

c. board level theory of operation, provided for the 5508A, 5518A, 10751A/B, and 10757A/B/C [board level theory is arranged in assembly number order (i.e., A1, A2 etc)].

8-7. TROUBLESHOOTING AND REPAIR

8-8. Troubleshooting information should be used as follows:

a. System troubleshooting procedures located in Section 8-A are designed to narrow trouble down to the instrument level. The 5528A Block Diagram description is located in the front of the section to provide the necessary background for effective troubleshooting.

b. Instrument troubleshooting procedures located in Section 8-B through 8-E are intended to isolate trouble to an assembly (pc board) of the respective instrument. Block diagram descriptions are also provided for the 5508A and 5518A. These descriptions provide instrument operation details beyond the 5528A block diagram description.

c. Component level troubleshooting information is provided for all the instruments in Sections 8-B through 8-E. These serve to pinpoint trouble to the stage or component level.

8-9. RECOMMENDED TEST EQUIPMENT

8-10. Table 1-4 in Section I lists the test equipment required for service. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

8-11. SERVICE AIDS

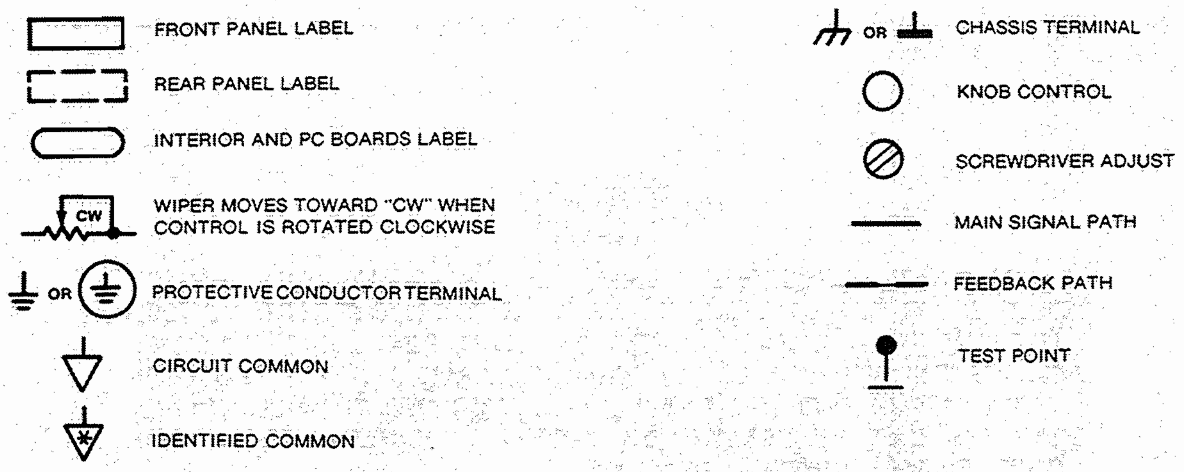
8-12. This system uses both metric and english hardware. Figures 6-1 through 6-9 should be used to determine the correct hardware descriptions, part numbers and the proper tools to employ for assembly and disassembly.

8-13. SCHEMATIC DIAGRAM SYMBOLS AND REFERENCE DESIGNATORS

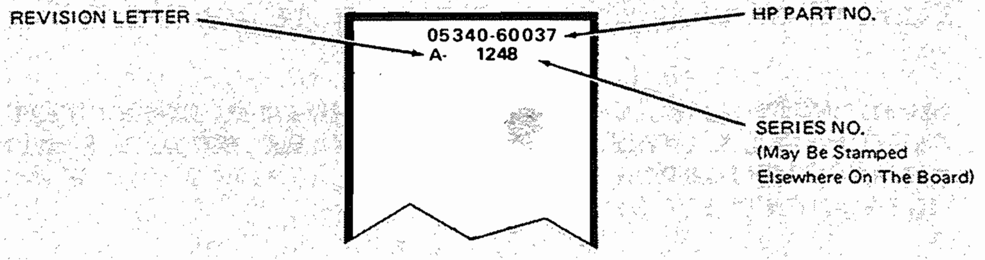
8-14. The logic symbology used on the schematic diagrams conform to ANSI Y32.14-1973 (IEEE Std. 91-1973). This standard supersedes MIL STD 806B. Definitions and explanations of the logic symbology used in this manual are contained in Paragraph 8-26 through 8-48.

8-15. Figure 8-1 shows some of the symbols used on the schematic diagrams. In the center of this figure, the scheme for printed circuit board identification is presented. Also shown at the bottom of Figure 8-1 is the system for reference designators, assemblies, and subassemblies.

SYMBOLS


FRONT PANEL LABEL
REAR PANEL LABEL
INTERIOR AND PC BOARDS LABEL
CW
WIPER MOVES TOWARD "CW" WHEN CONTROL IS ROTATED CLOCKWISE
OR
PROTECTIVE CONDUCTOR TERMINAL
CIRCUIT COMMON
IDENTIFIED COMMON
OR
CHASSIS TERMINAL
KNOB CONTROL
SCREWDRIVER ADJUST
MAIN SIGNAL PATH
FEEDBACK PATH
TEST POINT

PRINTED CIRCUIT BOARD IDENTIFICATION


REVISION LETTER
05340-60037
A- 1248
HP PART NO.
SERIES NO.
(May Be Stamped Elsewhere On The Board)

REFERENCE DESIGNATIONS

REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION. JACKS ARE THE STATIONARY CONNECTORS AND PLUGS ARE THE MORE MOVEABLE OF TWO CONNECTORS.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3

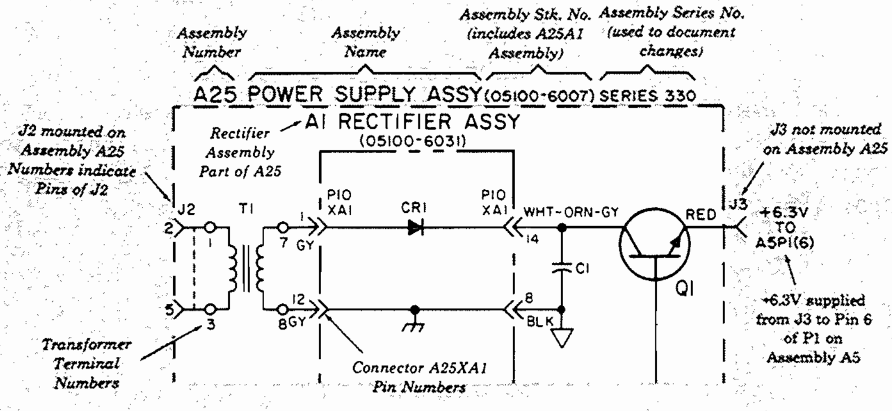

Assembly Number
Assembly Name
Assembly Stk. No. (includes A25A1 Assembly)
Assembly Series No. (used to document changes)
A25 POWER SUPPLY ASSY (05100-6007) SERIES 330
J2 mounted on Assembly A25 Numbers indicate Pins of J2
Rectifier Assembly Part of A25
A1 RECTIFIER ASSY
(05100-6031)
J3 not mounted on Assembly A25
J2
T1
P10
XA1
CR1
P10
XA1
WHT-ORN-GY
RED
J3
+6.3V TO A5P1(6)
2
1
7 GY
14
C1
Q1
5
3
12
8GY
8
BLK
+6.3V supplied from J3 to Pin 6 of P1 on Assembly A5
Transformer Terminal Numbers
Connector A25XA1 Pin Numbers

Figure 8-1. Schematic Diagram Notes

8-16. SAFETY CONSIDERATIONS

8-17. The following paragraphs contain warnings and cautions that must be followed for your protection and to avoid damage to the equipment.

WARNING

MAINTENANCE DESCRIBED HEREIN IS PERFORMED WITH POWER SUPPLIED TO THE EQUIPMENT AND WITH PROTECTIVE COVERS REMOVED. SUCH MAINTENANCE SHOULD BE PERFORMED ONLY BY SERVICE-TRAINED PERSONNEL WHO ARE AWARE OF THE HAZARDS INVOLVED (FOR EXAMPLE, FIRE AND ELECTRIC SHOCK). WHERE MAINTENANCE CAN BE PERFORMED WITHOUT POWER APPLIED THE POWER CORD SHOULD BE REMOVED.

BEFORE ANY REPAIR IS COMPLETED, ENSURE THAT ALL SAFETY FEATURES ARE INTACT AND FUNCTIONING, AND THAT ALL NECESSARY PARTS ARE CONNECTED TO THEIR PROTECTIVE GROUNDING MEANS.

100/240 VOLTS MAY BE PRESENT IN THE 5508A. USE EXTREME CAUTION WHEN WORKING ON OR NEAR THE PRIMARY POWER WIRING. VOLTAGE WILL BE PRESENT IN SOME AREAS EVEN IF THE LINE SWITCH IS SET TO OFF.

WARNING

FROM 1.8 KILOVOLTS TO 12 KILOVOLTS DC IS PRESENT ON THE ANODE OF THE LASER TUBE IN THE 5518A. EXERCISE EXTREME CAUTION WHEN WORKING INSIDE THE INSTRUMENT. THE HIGH VOLTAGE COULD CAUSE SERIOUS PERSONAL INJURY IF CONTACTED.

8-18. Safety Symbols

8-19. The following safety symbols are used on the instrument or in this manual.

⚠	Instruction manual symbol. The product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.
ϟ	Indicates dangerous voltage fed from internal or external sources exceeding 1000 volts.
⏚ OR ⏚	Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.
⏚	Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with the symbol must be connected to ground in the manner described in the installation (operating) manual, before operating the equipment.
⊥ OR ⊥	Frame and chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.
∼	Alternating current.
⎓	Direct current.
≂	Alternating or direct current.
WARNING	The WARNING signal denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury.
CAUTION	The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

8-20. Before and After Service Product Safety Checks

8-21. Visually inspect the interior of the serviced instrument for any signs of abnormal internally generated heat, such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine and remedy the cause of any such condition.

8-22. Using a suitable ohmmeter, check the resistance from the instrument enclosure to the ground pin on the power cord. The reading must be less than 0.5 ohm. Flex the power cord while making this measurement to determine whether intermittent discontinuities exist. The resistance check should also be performed from the laser head enclosure to the ground pin of the cord while flexing the interconnect cable.

8-23. Check any indicated front or rear panel ground terminals using the above procedures.

8-24. Check resistance from the instrument enclosure to line and neutral (tied together) with the power switch on and the power source disconnected. The minimum acceptable resistance is two megohms. Replace any component which results in a failure.

8-25. Check line fuse to verify that the correct value is installed.

8-26. LOGIC SYMBOLS

8-27. Logic symbols used in this manual conform to the American National Standard ANSI Y32.14-1973 (IEEE Std. 91-1973). This standard supersedes MIL-STD-806B. In the following paragraphs logic symbols are described. For further descriptions refer to HP Logic Symbology manual, part number 5951-6116.

8-28. Logic Concepts

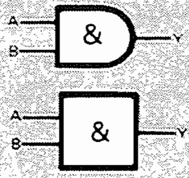
8-29. The binary numbers 1 and 0 are used in pure logic where 1 represents true, yes, or active and 0 represents false, no, inactive. These terms should not be confused with the physical quantity (e.g., voltage) that may be used to implement the logic, nor should the term "active" be confused with a level that turns a device on or off. A truth table for a relationship in logic shows (implicitly or explicitly) all the combinations of true and false input conditions and the result (output). There are only two basic logic relationships, AND and OR. The following illustrations assume two inputs (A and B), but these can be generalized to apply to more than two inputs.

AND Y is true if and only if A is true and B is true (or more generally, if all inputs are true).
Y=1 if and only if A=1 **and** B=1
$Y=A \bullet B$

TRUTH TABLE

A	B	Y
1	1	1
1	0	0
0	1	0
0	0	0

EQUIVALENT SYMBOLS

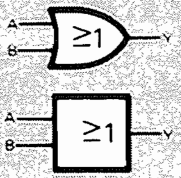


OR Y is true if and only if A is true or B is true (or more generally, if one or more input(s) is (are) true).
Y=1 if and only if A=1 **or** B=1
$Y=A+B$

TRUTH TABLE

A	B	Y
1	1	1
1	0	1
0	1	1
0	0	0

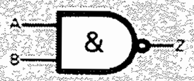
EQUIVALENT SYMBOLS



8-30. Negation

8-31. In logic symbology, the presence of the negation indication symbol **o** provides for the presentation of logic function inputs and outputs in terms *independent* of their physical values, the 0-state of the input or output being the 1-state of the symbol referred to the symbol description.

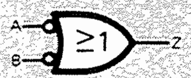
EXAMPLE 1



TRUTH TABLE

A	B	Z
1	1	0
1	0	1
0	1	1
0	0	1

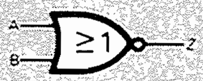
EXAMPLE 2



TRUTH TABLE

A	B	Z
1	1	0
1	0	1
0	1	1
0	0	1

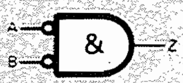
EXAMPLE 3



TRUTH TABLE

A	B	Z
1	1	0
1	0	0
0	1	0
0	0	1

EXAMPLE 4



TRUTH TABLE

A	B	Z
1	1	0
1	0	0
0	1	0
0	0	1

EXAMPLE 1	says that Z is *not* true if A is true *and* B is true or that Z is true if A *and* B are *not* both true. $\overline{Z}$=AB or Z=$\overline{AB}$. This is frequently referred to as NAND (for NOT AND).
EXAMPLE 2	says that Z is true if A is *not* true or if B is *not* true. Z=$\overline{A}+\overline{B}$. Note that this truth table is identical to that of Example 1. The logic equation is merely a DeMorgan's transformation of the equations in Example 1. The symbols are equivalent.
EXAMPLE 3	$\overline{Z}$=A+B or Z=$\overline{A}+\overline{B}$ and.
EXAMPLE 4	Z=$\overline{A \bullet B}$, also share common truth table and are equivalent transformations of each other. The NOT OR form (Example 3) is frequently referred to as NOR.

8-32. Logic Implementation and Polarity Indication

8-33. Devices that can perform the basic logic functions, AND or OR, are called gates. Any device that can perform one of these functions can also be used to perform the other if the relationship of the input and output voltage levels to the logic variables 1 and 0 is redefined suitably.

8-34. In describing the operation of electronic logic devices, the symbol H is used to represent a "high level", which is a voltage within the more-positive (less-negative) of the two ranges of voltages used to represent the binary variables. L is used to represent a "low level", which is a voltage within the less-positive (more-negative) range.

8-35. A function table for a device shows (implicitly or explictly) all the combinations of input conditions and the resulting output conditions.

8-36. In graphic symbols, inputs or outputs that are active when at the high level are shown without polarity indication. The polarity indicator symbol ◺ denotes that the active (one) state of an input or output *with respect to the symbol to which it is attached to* is the low level.

EXAMPLE 5 assume two devices having the following function tables.

DEVICE #1
FUNCTION TABLE

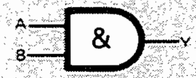
A	B	Y
H	H	H
H	L	L
L	H	L
L	L	L

DEVICE #2
FUNCTION TABLE

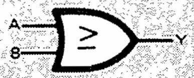
A	B	Y
H	H	H
H	L	H
L	H	H
L	L	L

POSITIVE LOGIC by assigning the relationship H=1, L=0 at both input and output, Device #1 can perform the AND function and Device #2 can perform the OR function. Such a consistent assignment is referred to as positive logic. The corresponding logic symbols would be:

DEVICE #1

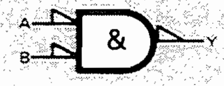


DEVICE #2

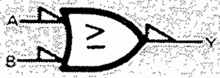


NEGATIVE LOGIC alternatively, by assigning the relationship H=0, L=1 at both input and output, Device #1 can perform the OR function and Device #2 can perform the AND function. Such a consistent assignment is referred to as negative logic. The corresponding logic symbols would be:

DEVICE #1



DEVICE #2

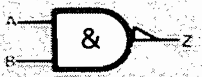


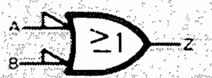
8-37. MIXED LOGIC. The use of the polarity indicator symbol (   ) automatically invokes a mixed-logic convention. That is, positive logic is used at the inputs and outputs that do not have polarity indicators, negative logic is used at the inputs and outputs that have polarity indicators.

EXAMPLE 6
FUNCTION TABLE

A	B	Z
H	H	L
H	L	H
L	H	H
L	L	H

This may be shown either of two ways:



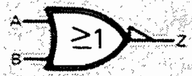


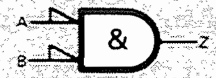
Note the equivalence of these symbols to examples 1 and 2 and the fact that the function table is a positive-logic translation (H=1, L=0) of the NAND truth table, and also note that the function table is the negative-logic translation (H=0, L=1) of the NOR truth table, given in Example 3.

EXAMPLE 7
FUNCTION TABLE

A	B	Z
H	H	L
H	L	L
L	H	L
L	L	H

This may be shown either of two ways:





Note the equivalence of these symbols to examples 3 and 4 and the fact that the function table is a positive-logic translation (H=1, L=0) of the NOR truth table, and also note that the function table is the negative-logic translation (H=0, L=1) of the NAND truth table, given in Example 1.

8-38. It should be noted that one can easily convert from the symbology of positive-logic merely by substituting a polarity indicator (◺) for each negative indicator (o) while leaving the distinctive shape alone. To convert from the symbology of negative-logic, a polarity indication (◺) is substituted for each negation indicator (o) and the OR shape is substituted for the AND shape or vice versa.

8-39. It was shown that any device that can perform OR logic can also perform AND logic and vice versa. DeMorgan's transformation is illustrated in Example 1 through 7. The rules of the transformation are:

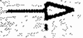
1. At each input or output having a negation (o) or polarity (◺) indicator, delete the indicator.
2. At each input or output not having an indicator, add a negation (o) or polarity (◺) indicator.
3. Substitute the AND symbol D for the OR symbol ⊃ or vice versa.

   These steps do not alter the assumed convention; positive-logic stays positive, negative-logic stays negative, and mixed-logic stays mixed.

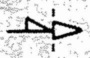
8-40. The choice of symbols may be influenced by these considerations: (1) The operation being performed may best be understood as AND or OR. (2) In a function more complex than a basic gate, the inputs will usually be considered as inherently active high or active low (e.g., the J and K inputs of a J-K flip-flop are active high and active low, respectively). (3) In a chain of logic, understanding and the writing of logic equations are often facilitated if active low or negated outputs feed into active low or negated inputs.

8-41. Other Symbols

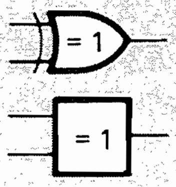
8-42. Additional symbols are required to depict complex logic diagrams, as follows:



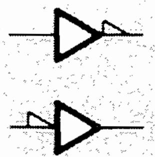
Dynamic input activated by transition from a low level to a high level. The opposite transition has no effect at the output.



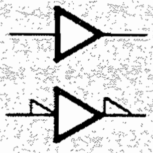
Dynamic input activated by transition from a high level to a low level. The opposite transition has no effect at the output.



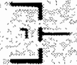
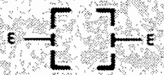
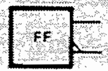
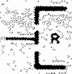
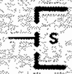
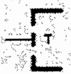
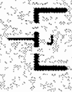
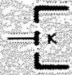
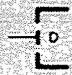
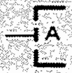
Exclusive OR function. The output will assume its indicated active level if and only if one and only one of the two inputs assumes its indicated active level.



Inverting function. The output is low if the input is high and it is high if the input is low. The two symbols shown are equivalent.

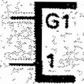


Noninverting function. The output is high if the input is high and it is low if the input is low. The two symbols shown are equivalent.

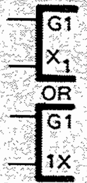
	OUTPUT DELAY. The output signal is effective when the input signal returns to its opposite state.
	EXTENDER. Indicates when a logic function increases (extends) the number of inputs to another logic function.
	FLIP-FLOP. A binary sequential element with two stable states: a set (1) state and a reset (0) state. Outputs are shown in the 1 state when the flip-flop is set. In the reset state the outputs will be opposite to the set state.
	RESET. A 1 input will reset the flip-flop. A return to 0 will cause no further effect.
	SET. A 1 input will set the flip-flop. A return to 0 will cause no further action.
	TOGGLE. A 1 input will cause the flip-flop to change state. A return to 0 will cause no further action.
	J INPUT. Similar to the S input except if both J and K (see below) are at 1, the flip-flop changes state.
	K INPUT. Similar to the R input (see above).
	D INPUT (Data). Always dependent on another input (usually C). When the C and D inputs are at 1, the flip-flop will be set. When the C1 is 1 and the D is 0, the flip-flop will reset.
	Address symbol has multiplexing relationship at inputs and demultiplexing relationship at outputs.

8-43. Dependency Notation "C" "G" "V" "F"

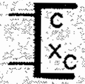
8-44. Dependency notation is a way to simplify symbols for complex IC elements by defining the existence of an AND relationship between inputs, or by the AND conditioning of an output by an input without actually showing all the elements and interconnections involved. The following examples use the letter "C" for control and "G" for gate. The dependent input is labeled with a number that is prefixed (e.g., 1X) or subscripted (e.g., X_1). They both mean the same thing. The letter "V" is used to indicate an OR relationship between inputs or between inputs and outputs with this letter (V). The letter "F" indicates a connect-disconnect relationship. If the "F" (free dependency) inputs or outputs are active (1) the other usual normal conditions apply. If one or more of the "F" inputs are inactive (0), the related "F" output is disconnected from its normal output condition (it floats).



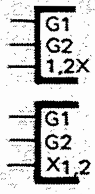
The input that controls or gates other inputs is labeled with a "C" or a "G", followed by an identifying number. The controlled or gated input or output is labeled with the same number. In this example, "1" is controlled by "G1".



When the controlled or gated input or output already has a functional label (X is used here), that label will be prefixed or subscripted by the identifying number.



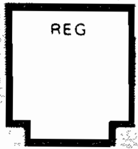
If a particular device has only one gating, or control input then the identifying number may be eliminated and the relationship shown with a subscript.



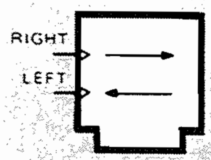
If the input or output is affected by more than one gate or control input, then the identifying numbers of each gate or control input will appear in the prefix or subscript, separated by commas. In this example "X" is controlled by "G1" and "G2".

8-45. Control Blocks

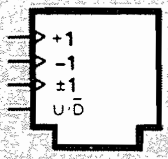
8-46. A class of symbols for complex logic are called control blocks. Control blocks are used to show where common control signals are applied to a group of functionally separate units. Examples of types of control blocks follow.



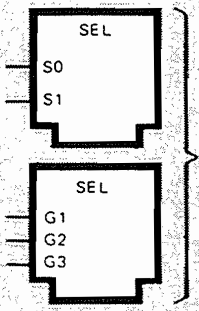
Register control block. This symbol is used with an associated array of flip-flop symbols to provide a point of placement for common function lines, such as a common clear.



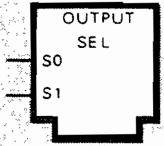
Shift register control block. These symbols are used with any array of flip-flop symbols to form a shift register. An active transition at the inputs causes left or right shifting as indicated.



Counter control block. The symbol is used with an array of flip-flops or other circuits serving as a binary or decade counter. An active transition at the +1 or −1 input causes the counter to increment one count upward or downward, respectively. An active transition at the +1 input causes the counter to increment one count upward or downward depending on the input at an up/down control.



Selector control block. These symbols are used with an array of OR symbols to provide a point of placement for selection (S) or gating (G) lines. The selection lines enable the input designated 0, 1, ... n of each OR function by means of a binary code where S0 is the least significant digit. If the 1 level of these lines is low, polarity indicators (◺) will be used. The gating lines have an AND relation with the respective input of each OR function: G1 with the inputs numbered 1, G2 with the inputs numbered 2, and so forth. If the enabling levels of these lines is low, polarity indicators (◺) will be used.



Output selector control block. This symbol is used with a block symbol having multiple outputs to form a decoder. The selection lines enable the output designated 0, 1, ... n of each block by means of a binary code where S0 is the least significant digit. If the 1 level of these lines is low, polarity indicators (◺) will be used.

8-47. Complex Logic Devices

8-48. Logic elements can be combined to produce complex devices that can perform more difficult functions. A control block symbol can be used to simplify understanding of many complex devices. Several examples of complex devices are given here. These examples are typical of the symbols used in schematic diagrams in this manual.

Reference Designation

5508A

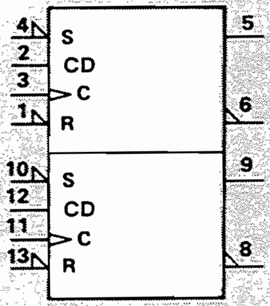
A1U3, A3U22, A3U23,
A3U29, A3U30,
A3U54, A3U56

5518A

A3U3

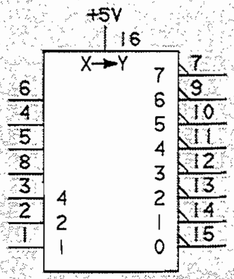
Part Number

1820-1112
SN74LS74N



Description: The dual D-type flip-flop consists of two independent D-type flip-flops. The information present at the data (D_C) input is transferred to the active-high and active-low outputs on a low-to-high transition of the clock (C) input. The data input is then locked out and the outputs do not change again until the next low-to-high transition of the clock input. The set (S) and reset (R) inputs override all other input conditions: when (S) is low, the active-high output is forced high; when reset (R) is low, the active-high output is forced low. Although normally the active-low output is the complement of the active-high output, simultaneous low inputs at the set and reset will force both the active-low and active-high outputs to go high at the same time on some D-type flip-flops. This condition will exist only for the length of time that both set and reset inputs are held low. The flip-flop will return to some indeterminate state when both the set and reset inputs are returned to the high state.

Reference Designation
5508A
A2U10, A2U19, A2U21,
A3U27, U51
Part Number
1820-1216



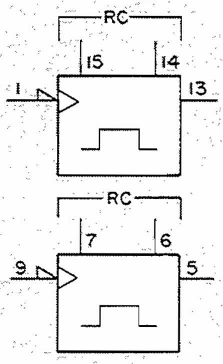
Description: The decoder/demultiplexer decodes one-of-eight lines dependent on the conditions at the three binary select inputs and the three enable inputs. The enable inputs consist of two active-low and one active-high. The function table is as follows:

FUNCTION TABLE

INPUTS (PINS)					OUTPUT (PINS)							
ENABLE		SELECT										
6	4,5	3	2	1	15	14	13	12	11	10	9	7
X	H	X	X	X	H	H	H	H	H	H	H	H
L	X	X	X	X	H	H	H	H	H	H	H	H
H	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	H	H	H	H	H	L	H	H	H	H
H	L	H	L	L	H	H	H	H	L	H	H	H
H	L	H	L	H	H	H	H	H	H	L	H	H
H	L	H	H	L	H	H	H	H	H	H	L	H
H	L	H	H	H	H	H	H	H	H	H	H	L

H = high level, L = low level, X = irrelevant

Reference Designation
5508A
A3U32
Part Number
1820-1423
74LS123



Description: This integrated circuit contains dual retriggerable monostable multivibrators. These are dc triggered multivibrators whose output pulse width can be controlled by three methods. The basic pulse time is programmed by selection of external R and C values. Once triggered, the basic pulse width may be extended by retriggering and gated low-level-active or high-level-active inputs, or be reduced by use of the overriding clear.

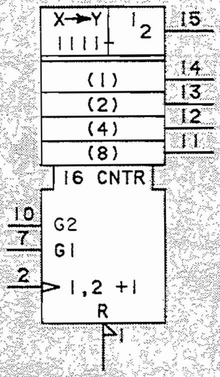
Reference Designation

5508A

A3U1, A3U2, A3U8,
A3U40, A3U45, A3U46

Part Number

1820-1430
SN74LS161


X→Y
1111
1
2
15
(1)
(2)
(4)
(8)
14
13
12
11
16 CNTR
10
G2
7
G1
2
1,2 +1
R
1

Description: This IC is a 4-bit binary synchronous counter with direct clear. Synchronous operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincident with each other when so instructed by the count enable inputs and internal gating. A buffered clock input triggers the four flip-flops on the rising (positive-going) edge of the clock input waveform. The counters are fully programmable; that is, the outputs may be preset to either level. The clear function is asynchronous and a low level at the clear input sets all four f/f outputs low regardless of the other inputs.

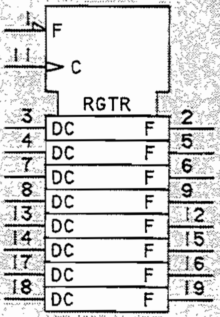
Reference Designation

5508A

A3U7, A3U13, A3U33, A3U39

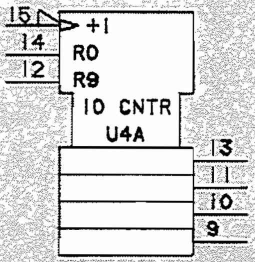
Part Number

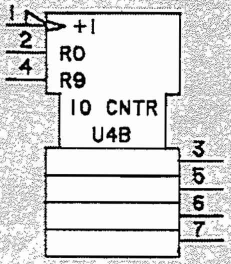
1820-1997
74LS374


1
F
11
C
RGTR
3
DC
F
2
4
DC
F
5
7
DC
F
6
8
DC
F
9
13
DC
F
12
14
DC
F
15
17
DC
F
16
18
DC
F
19

Description: This IC is an 8-bit D-type flip-flop. Information present at the DC inputs is transferred to the F outputs on the positive going edge of the clock (pin 11). A LOW at RESET (pin 1) will reset the flip-flops and all outputs (pins 2, 5, 6, 9, 12, 15, 16, 19) will be low.

Reference Designation
5518A
A3U4
Part Number
1820-2078
SN74LS490





Description: This IC is a dual 4-bit decade counter consisting of eight master-slave flip-flops. Each counter has individual clock, clear, and set-to-nine inputs. A high to the clear input resets all four outputs low. A high input to set-to-nine sets Q_A and Q_D high, Q_B and Q_C low. The function tables are shown as follows:

**BCD
COUNT SEQUENCE
(EACH COUNTER)**

COUNT	OUTPUT (PINS)			
	7	6	5	3
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H

**CLEAR/SET-TO-9
FUNCTION TABLE
(EACH COUNTER)**

INPUT (PINS)		OUTPUT (PINS)			
2	4	3	5	6	7
H	L	L	L	L	L
L	H	H	L	L	H
L	L	COUNT			

H = high level, L = low level

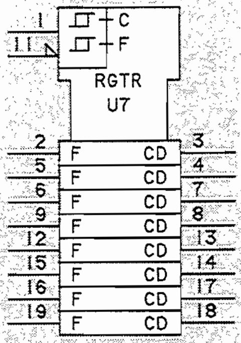
Reference Designation

5508A

A1U7, A2U14

Part Number

1820-2102
SN74LS373



Description: This IC contains 8 D-Type latches and edge-triggered flip-flops. On the positive transition of the clock, the outputs will be set to the logic states that were setup at the inputs. The outputs are three state with the third state providing a high impedance output. The eight latches are transparent D-type latches meaning that while the enable (pin 11) is high, the outputs will follow the data inputs. When the enable is taken low, the output will be latched at the level of the data that was setup. The function table is as follows:

FUNCTION TABLE

OUTPUT CONTROL PIN 1	ENABLE G PIN 11	INPUT	OUTPUT
L	H	H	H
L	H	L	L
L	L	X	Q_0
H	X	X	Z

X = irrelevant

Q_0 = level of Q before the indicated steady-state input conditions were established.

Z = off (high-impedance) state of a 3-state output.

SECTION VIII-A
5528A LASER MEASUREMENT SYSTEM

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SECTION VIII-A
5528A LASER MEASUREMENT SYSTEM

8-A-1. 5528A BLOCK DIAGRAM DESCRIPTION

8-A-2. Introduction

8-A-3. Following is an overall block diagram description of the Laser Measurement System. This describes the instruments on an overall basis in order to provide an understanding of the major functions. Detailed block diagram descriptions for the 5508A Measurement Display and the 5518A Laser Head are provided in Sections 8-B and 8-C, respectively.

8-A-4. Figure 8-A-4, the 5528A Block Diagram, shows the overall block diagram of the system. The system consists of the 5508A Measurement Display, 5518A Laser Head, 10751A/B Air Sensor, 10757A/B/C Material Temperature Sensor, and Measurement Optics used for making various measurements. The Measurement Optics for distance measurement are shown in Figure 8-A-4. One 10766A Linear Interferometer and two 10767A Retroreflector are required for distance measurements.

8-A-5. 5518A Laser Head

8-A-6. The 5518A consists of a laser assembly, laser tuning control circuits, a beam sampler assembly, a high voltage power supply, the reference frequency receiver and the measurement frequency receiver. The Laser Assembly outputs two laser frequencies, F1 and F2, which differ in frequency by 1.5 to 2.0 MHz. Each frequency is output as polarized light. F1 and F2 are linearly polarized and their polarizations are perpendicular to each other as shown in Figure 8-A-4.

8-A-7. The Sampler Assembly samples some of the laser output in order to monitor laser tuning and to generate the Reference Frequency Signal. For laser tuning control, some of the sample is directed onto a photodiode in the tuning control circuitry. The photodiode response current is proportional to the power in each laser frequency depending on which frequency is passed by an optical switch. A liquid crystal and a polarizer in the sampler assembly form the switch. The switch has two states which are alternately enabled. Each state allows one of the frequencies to pass onto the photodiode. A subtracting sample and hold circuit generates an error signal that is proportional to any difference in optical power. The error signal is used to control the laser assembly such that the power in each laser frequency is equalized.

8-A-8. The Sampler Assembly also directs some of the laser beam onto another photodiode. This photodiode is part of the Reference Receiver. The reference receiver photodiode uses a polarizer that is oriented at 45 degrees to both laser beam polarizations. The optical power that is passed by this polarizer varies sinusoidally at the difference frequency between F2 and F1. The reference receiver converts this optical power and generates the Reference Frequency, a TTL squarewave of frequency, F2-F1.

8-A-9. The Measurement Receiver works like the reference receiver. The measurement receiver detects the difference frequency after the laser frequencies pass through the Measurement Optics and return to the 5518A.

8-A-10. Laser Warm-Up Period. A warm-up period is required to bring the laser assembly to an initial operating temperature. When power is first applied, the measurement and reference receivers are disabled and a glass rod within the laser assembly is heated. After the warm-up period, the tuning control circuitry begins the optical power measurements. At this point the 5518A rear panel indicator READY will be blinking. After the power difference between F2 and F1 has been maintained at zero, the READY indicator stops blinking and illuminates. At this point the measurement and reference receivers are enabled and a measurement can be performed.

8-A-11. 5508A Measurement Display

8-A-12. The 5508A consists of two frequency multipliers, two pulse converters, analog to digital converter circuitry, a processor, a front panel keyboard and display, and power supplies.

8-A-13. The frequency multipliers are phase-locked loop circuits that multiply the input frequencies by 16 in order to extend the resolution of the laser measurement. The measurement and reference pulse counters record any change in frequency between the measurement and reference frequency signals. Whenever the measurement frequency changes relative to the reference frequency, the pulse counters accumulate a difference in count. The measurement frequency changes whenever the measurement optics move relative to each other. The 5508A processor weights the pulse difference according to the measurement mode and units before displaying the measurement. For the weight (value) of each count in straightness or angular measurements, the 5508A uses constants stored in read only memory. For a distance measurement, however, the 5508A requires a constant and the compensation number.*

8-A-14. The Processor controls the sequence of operations according to the measurement mode selected. This includes transfer and routing of data, calculations, and display functions. The processor determines the difference count by subtracting the contents of the two pulse counters. When either counter is half full it interrupts the processor which then reads the value of each counter, resets them, and stores the difference count. Each successive pulse difference that is detected is added to previous difference counts in read/write memory.

8-A-15. The Keyboard-Display allows the operator to select measurement modes and parameter values. It also has provisions for reset and record functions. The display is an all numeric, LED readout consisting of nine and a half digits plus a sign indicator.

8-A-16. The HP-IB circuits allow the 5508A to be interfaced with an external controller or recording device. Data may be either input or output via the interface bus. The 5508A allows all front panel keyboard functions to be programmed via HP-IB.

8-A-17. The Remote Control Unit allows the display to be reset from a remote location. Provision is also made to remotely select the record function to output data to calculators, plotters, and displays.

8-A-18. Compensation Number

8-A-19. The compensation number has two factors. A factor that compensates for the speed of light in air and a factor that compensates for material expansion. Both factors can be determined automatically or manually. For manual velocity of light compensation, the operator can enter the V.O.L. compensation number using the VOL key. For material expansion compensation, the operator can enter an expansion coefficient and an average material temperature value. For automatic compensation, the 10751A/B Air Sensor and up to three 10757A/B/C Material Temperature Sensors are used. The 5508A derives the compensation factors directly from the sensor measurements and the manually entered expansion coefficient.

8-A-20. The 10751A Air Sensor measures air temperature and pressure, and has provision for manually indicating 25%, 50% or 75% relative humidity. The Air Sensor outputs connect to an analog-to-digital converter in the 5508A where the measurement data is digitized for use by the processor.

**It is possible to use compensation in straightness measurements but this is not necessary.*

8-A-21. Up to three 10757A/B/C Material Temperature Sensors can be used to sense the temperature of the workpiece. This information is also sent to the analog-to-digital converter to be alternately sampled with the air compensation data for use by the processor. The Material Temperature Sensor measurements are used by the 5508A only when an expansion coefficient other than zero is entered by the operator. Material expansion compensation is used to reference distance measurements to 20°C (68°F). When material expansion compensation is used, the distance measurement is displayed to show the true value as it would be if the material were at a constant 20°C. When more than one Material Temperature Sensor is used the 5508A calculates an average temperature — no consideration is made for thermal gradients. Therefore, extreme variations in temperature over the workpiece should be avoided.

8-A-22. If a distance measurement were performed on a material at 20°C in a perfect vacuum, the only weighting requiring would be to multiply the pulse difference by the appropriate fraction of the laser wavelength. Each pulse would be 1/32 of the wavelength in vacuum (the wavelength in vacuum is a known constant). However, the wavelength of light when it travels through air depends on its velocity in air. This in turn is dependent upon air temperature, pressure, and relative humidity. The 5508A calculates the V.O.L. compensation factor from the 10751A/B measurements in order to correct for true wavelength in air.

8-A-23. Power-Up Self Test and Warm-Up Countdown

8-A-24. The 5508A extensively tests internal circuitry during the Power-Up Self Test. After the 5508A executes the self test, it begins a ten minute countdown. The countdown is interrupted when the 5518A enables its output signals. If all three 5518A signals are present, the 5508A displays LASr UP. If Measurement Optics are not aligned, then only REFERENCE FREQUENCY will be present and PA Error will be displayed. The Power-Up Self Test is described in Section III and IV.

8-A-25. Beam Strength Signal

8-A-26. BEAM STRENGTH is a signal that is proportional to the strength of the Measurement Frequency Signal at the photodiode in the Measurement Receiver. When the 5518A is ready for use, BEAM STRENGTH, MEASUREMENT FREQUENCY and REFERENCE FREQUENCY are enabled.

8-A-27. Basic Measurement Technique

8-A-28. The theory of operation is described below in terms of distance measurements. Variations in the theory of operation for angular and straightness measurements is due to the difference in the function of the Measurement Optics. Angular and straightness optics theory is discussed in Section 8-E, Optics.

8-A-29. The configuration of the Measurement Optics for a distance measurement is shown in Figure 8-A-1, Distance Measurement Set-up.

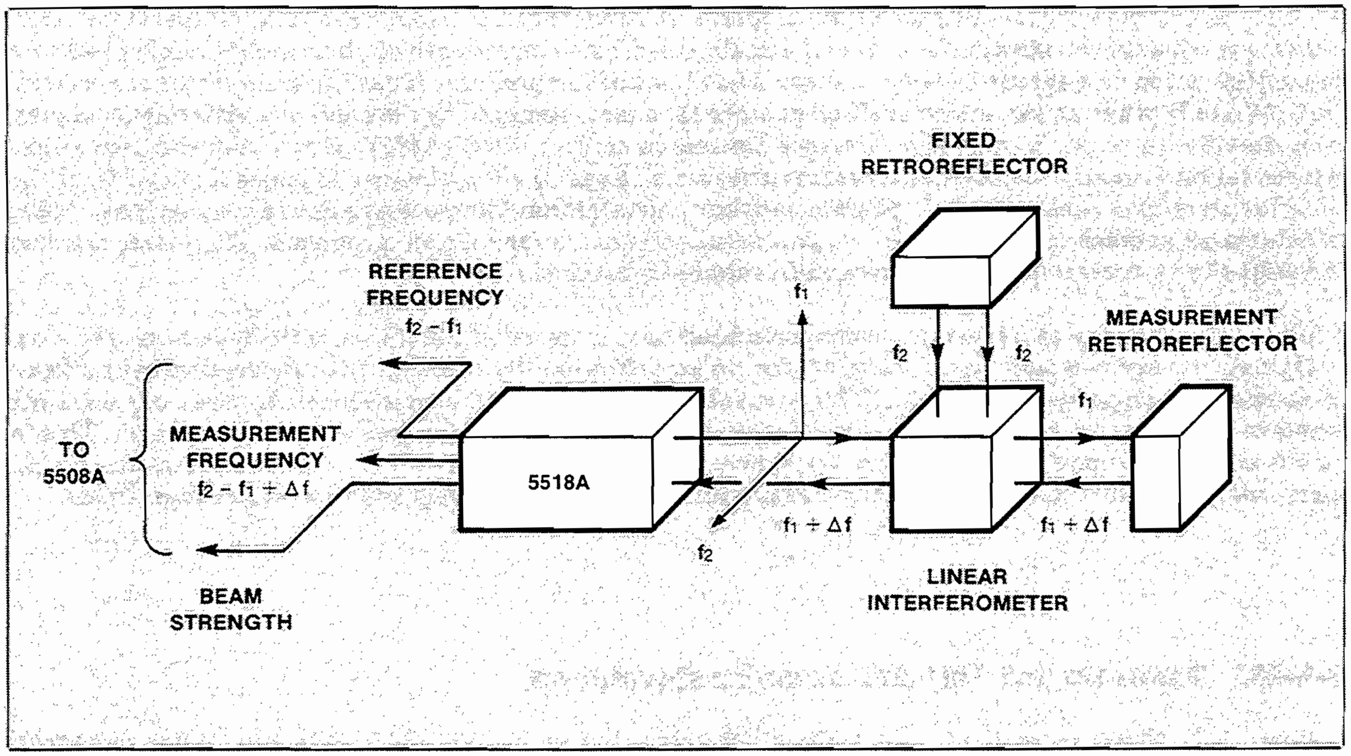


Figure 8-A-1. Distance Measurement Set-up

8-A-30. As shown in Figure 8-A-1 the Linear Interferometer is configured with a fixed Retroreflector and a moveable (measurement) Retroreflector. The Interferometer is a polarizing beamsplitter that reflects one polarization (frequency) and transmits the other. The beamsplitter is oriented such that the reflected and transmitted beams are at right angles to each other. If the Measurement Retroreflector is also fixed at a constant distance, the phase relationship of F2 and F1 where they recombine at the beam splitter varies sinusoidually at the difference frequency, F2-F1. Under this condition the pulse counters in the 5508A accumulate no difference count because the measurement frequency equals the reference frequency. When the Measurement Retroreflector moves with respect to the beam splitter the phase relationship between F2 and F1 will change. The measurement frequency will now have instantaneous frequency changes (delta F), caused by changes in phase of F1. Referring to Figure 8-A-1, the phase of F1 where it recombines at the beamsplitter depends on the wavelength of F1 and the number of wavelengths in the measurement path. Changes in the distance of the measurement path are therefore recorded as phase modulation of F1. Phase modulation causes the measurement pulse counter to lead or follow the reference pulse counter depending on the direction of movement. The 5508A accumulates a count difference between the two pulse counters whenever the measurement frequency is modulated. The difference is proportional to travel and is converted to distance units for display. The conversion factors are the compensation number and a units factor (inches or millimetres).

8-A-31. Smoothing

8-A-32. When smoothing is enabled, the 5508A display is not updated immediately after a pulse count difference is detected. Instead increments of the latest difference count are added to the total display value a fraction at a time. This smoothes out display jitter due to vibration. The smoothing function can be defeated using the RESOL key. The 5508A accumulates a count difference between the two pulse counters whenever the measurement frequency is modulated. The difference is proportional to travel and is converted to distance units for display. The conversion factors are the compensation number and a units factor (inches or millimetres).

8-A-33. SYSTEM TROUBLESHOOTING

8-A-34. Introduction

8-A-35. Information is summarized in the following paragraphs to help identify system failures. Some failures will have several symptoms. Observation of these symptoms with knowledge of the system functions will frequently provide enough indication to begin troubleshooting a particular instrument. Block diagram descriptions provide the background necessary for effective troubleshooting. The 5508A and 5518A block diagram descriptions provide useful theory of operation details beyond the 5528A Block Diagram description.

8-A-36. The Instrument Isolation Procedures in this section are provided to help verify operation of individual instruments in the system. In general, the Isolation Procedures and other troubleshooting information in this section should be used before consulting the Instrument Troubleshooting and Repair Procedures in Section 8-B, 8-C, 8-D, and 8-E.

8-A-37. Signal Connection and Indicator Diagram

8-A-38. Figure 8-A-3 shows the electrical locations of the major circuit functions, LED indicators, switches and power supplies in the 5528A system. All P.C. board edge and pin connector designations for the major electrical signals are provided in the figure. This figure can be used when tracing signal paths during troubleshooting. Note that MEASUREMENT FREQUENCY, REFERENCE FREQUENCY and BEAM STRENGTH SIGNALS are enabled only when the laser tuning is stabilized following the warm-up period.

8-A-39. Troubleshooting Tables

8-A-40. Indicator conditions and error messages are tabulated and can be used to identify causes and locations of failures. Tables 8-A-2 and 8-A-3 list causes and possible failure locations for the described indicator conditions. Table 8-A-5, Error Messages lists causes and possible failure locations for the 5508A error messages. Comparison of simultaneous indications and error messages will help to rapidly narrow down trouble when possible failure locations are common to each tabulated indication and error message. The possible failure locations are listed beneath the cause entries in the tables. They are listed in descending order according to difficulty of troubleshooting required. Related troubleshooting procedures are listed adjacent to failure locations to which they apply. In general, the system power supplies and proper user operation should be verified when first troubleshooting any problem.

8-A-41. Indicators

8-A-42. External indicators are provided on the 5518A and 5508A to indicate normal operation and to help identify the nature of system failures. The Indicator Conditions Tables, Table 8-A-2 and Table 8-A-3, summarize indicator conditions for various failures. The tables should be used with knowledge of the indicator functions. In particular, the READY indicator has three states (off, blinking on, and on) to indicate 5518A laser tuning status. Indicator functions are summarized at the end of the 5508A and 5518A Block Diagram Descriptions.

8-A-43. The 5508A also has internal indicators. These indicators can be accessed by removing the 5508A top cover. Loosen the pozidrive screw on the rear of the top cover and slide the cover rearward. Assemblies A1 and A2 are hinge-mounted to the chassis. The hinges allow inspection of the interior of the instrument. A1 and A2 can be separated according to instructions stenciled on A1. See Figure 8-B-2, 5508A Assembly and Cable Designations.

Table 8-A-1. 5508A Internal Indications

5508A Internal Indicator	Assembly/Schematic Location	Function
"MEAS LOL" LED	A3	When lighted, indicates Measurement Frequency Signal problem has occurred
"REF LOL" LED	A3	When lighted, indicates Reference Frequency Signal problem has occurred
"+5" LED	A5	Supply Indicator
"+15" LED	A5	Supply Indicator
"–15" LED	A5	Supply Indicator
"+15 HEAD" LED	A5	Supply Indicator

Table 8-A-2. 5508A External Indicator Conditions

Indicator: Condition/Related Indicator	Cause: Possible Failure Location	Troubleshooting
BEAM STRENGTH: Meter reads **zero**/READY indicator is lighted, but SIGNAL indicator is extinguished:	**Measurement receiver not receiving sufficient laser measurement signal:**	
	Laser beam attenuation	Check operating environment for air temperature gradients or smoke near the path of the laser beam.
	Turret not configured properly	5518A Isolation (Para 8-A-70)
	Measurement Optics, misalignment	5518A Isolation (Para 8-A-70)
	Measurement Optics, beam attenuation	Section III: Optics Cleaning
	Measurement Optics, broken	5518A Isolation (Para 8-A-70)
	Turret assembly not functioning properly	5518A Isolation
	Measurement Receiver failure	5518A Isolation (Para 8-A-70)
Meter reads zero/READY and SIGNAL indicators are lighted	Beam strength signal failure	5508A Isolation (Para 8-A-65)
LASER ON: Extinguished	+5V Supply failure	Power Supply Troubleshooting Procedures (Para 8-A-33)

Table 8-A-3. 5518A Indicator Conditions

Indicator: Condition/Related Indicator	Cause: Possible Failure Location	Troubleshooting
LASER ON: Indicator extinguished	**+15V (Head) supply failure:**	
	5508A power supplies and fuses	Power Supplies Troubleshooting (Para 8-A-83)
	5518A power distribution or fuse	Power Supplies Troubleshooting (Para 8-A-83)
READY: Indicator extinguishes during a measurement and begins to blink	**Reference Frequency Signal dropout:**	
	5518A Reference Receiver failure	5518A Trouble Isolation Procedures (Para 8-C-43)
	5518A Laser Assembly tuning failure	5518A Trouble Isolation Procedures (Para 8-C-43)
	Electromagnetic interference in operating environment	5518A Isolation (Para 8-A-70) 5518A Trouble Isolation Procedures (Para 8-C-43)
READY: Indicator blinks within 5 minutes after power-up, blinks for less than 3 minutes, goes off, then repeats cycle	**5518A failure:**	
	5518A Laser Assembly tuning failure	5518A Trouble Isolation Procedures (Para 8-C-43)
READY: Indicator takes longer than 5 minutes from power-up to start blinking	**5518A failure:**	
	5518A Laser Assembly tuning failure	5518A Trouble Isolation Procedures (Para 8-C-43)
SIGNAL: Indicator does not light when measurement optics are positioned/READY indicates normal operation	**Measurement Receiver not receiving sufficient laser measurement signal:**	
	Laser beam attenuation	Check operating environment for air temperature gradients or smoke in the path of the laser beam
	Turret not configured properly	5518A Isolation (Para 8-A-70)
	Measurement Optics, misalignment	5518A Isolation (Para 8-A-70)
	Measurement Optics, beam attenuation	Section III: Optics Cleaning
	Measurement Optics, broken	5518A Isolation (Para 8-A-70)
	Turret assembly not functioning properly	5518A Isolation (Para 8-A-70)
	Measurement Receiver failure	5518A Isolation (Para 8-A-70)

8-A-44. Error Messages

8-A-45. Error messages are displayed by the 5508A that identify measurement errors, operator errors, and certain hardware failures. The error messages are assigned priority by the 5508A. If error conditions occur simultaneously, only the highest priority error message will be displayed. If error conditions are temporary or intermittent, the error message can be cleared by pressing front panel keys. Hd Error, PA Error, and SL Error can only be cleared by the RESET key (pressing RESET also causes loss of laser measurement data). All other error messages can be cleared by pressing any front panel key. Error messages will reappear on the display if error conditions are not corrected. After the highest priority error message has been cleared, the 5508A will display lower priority error messages if conditions remain.

Table 8-A-4. 5508A Error Message Priority

Hd Error
PA Error
SL Error
Lr Error
Sr Error
P1 Error
P2 Error
P3 Error
AE Error
AP Error
AH Error

8-A-46. The following error messages should only appear on the 5508A display in response to keyboard operation. Key descriptions and the Operator's Check are located in Section III.

Error Message	Associated Front Panel Key
A Error	MATL TEMP
C Error	V.O.L.
Or Error	All SETUP keys
Ur Error	All SETUP keys

8-A-47. Error messages, causes and possible failure locations are listed in Table 8-A-5 Error Messages. Indicators whose condition may help verify failure locations are listed adjacent to the possible failure locations to which they apply.

Table 8-A-5. Error Messages

Error Message	Condition	Cause: Possible Fault Location	Troubleshooting
A Error	Material temperature average error	This error can be displayed only by pressing the MATL TEMP key	
		One of the material temperature signals has exceeded ±1V range of 5508A A to D converter subsystem	10757A Isolation (Para 8-A-81)
AE Error	Air Sensor temperature signal error	Air temperature signal has exceeded ±1V range of 5508A A to D converter subsystem	10751 Isolation (Para 8-A-79)
AH Error	Air Sensor humidity signal error	Humidity switch signal has exceeded ±1V range of 5508A A to D converter subsystem	10751 Isolation (Para 8-A-79)
AP Error	Air Sensor pressure signal error	Air pressure signal has exceeded ±1V range of 5508A A to D converter subsystem	10751 Isolation (Para 8-A-79)
C Error	Compensation error (due to an Air Sensor) error)	This error can be displayed only by pressing V.O.L. key	Section III: V.O.L. Key Description
		One of the three signals from the 10751 has exceeded ±1V range of 5508A A to D Converter Subsystem	10751 Isolation (Para 8-A-79)
FAIL 1	Failed part of 5508A power-up self test	Power-up self test failure: Reference Frequency Channel failure (P/O 5508A A3)	5508A Isolation (Para 8-A-65) 5508A Trouble Isolation Procedures (Para 8-B-14)
FAIL 2	Failed part of 5508A power-up self test	Power-up self test failure: Measurement Frequency Channel failure (P/O 5508A A3)	5508A Isolation (Para 8-A-65) 5508A Trouble Isolation Procedures (Para 8-B-14)
FAIL 3	Failed part of 5508A power-up self test	Power-up self test failure: Measurement Frequency Pulse Counter or Counter Control Failure (P/O 5508 A3)	5508A Trouble Isolation Procedures (Para 8-B-14)

Table 8-A-5. Error Messages (Continued)

Error Message	Condition	Cause: Possible Fault Location	Troubleshooting
FAIL 4	Failed part of 5508A power-up self test	Power-up self test failure:	
		A to D Converter Subsystem failure (P/O 5508A A3)	5508A Trouble Isolation Procedures (Para 8-B-14)
Hd Error	Laser Head error	Instability or dropout of the Reference Frequency Signal at 5508A A3 Counter Board:	
READY: Indicator extinguished or blinking		5518A Laser Assembly tuning failure	Power Supplies Troubleshooting (Para 8-A-83) 5518A Trouble Isolation Procedures (Para 8-C-43)
READY: Indicator stays on		5508A Reference Frequency Channel failure (P/O 5508A A3)	5508A Isolation (Para 8-A-65) 5508A Trouble Isolation Procedures (Para 8-B-14)
READY: Indicator stays on		5518A Reference Receiver picking up noise or electromagnetic interference in operating environment	5518A Isolation (Para 8-A-70)
LASr FAIL	Flashes instead of LASer UP when 5518A is not yet ready for operation at the end of the warmup countdown	Reference Frequency signal not reaching 5508A Counter circuits	
5518A LASER ON: Indicator extinguished		5518A Power failure	Power Supply Troubleshooting (Para 8-A-83)
READY: Indicator lighted and SIGNAL: Indicator lights with optics aligned		5508A A3 Counter Board failure	5508A Isolation (Para 8-A-65)
READY: Indicator extinguished or blinking		5518A Laser Assembly tuning failure	5518A Trouble Isolation Procedures (Para 8-C-43)
READY: Indicator extinguished or blinking		5518A Reference Receiver failure	5518A Trouble Isolation Procedures (Para 8-C-43)

Table 8-A-5. Error Messages (Continued)

Error Message	Condition	Cause: Possible Fault Location	Troubleshooting
Lr Error	Listener too slow (HP-IB problem)	Improper user operation of HP-IB:	
		AUTORECORD key	Section III: Key Description and Operators Check
		RECORD Key	Section III: Key Description and Operators Check
		Slow HP-IB listener	Section III: Key Description and Operators Check
		5508A HP-IB subsystem failure	5508A Trouble Isolation Procedures (Para 8-B-14)
Or Error	Overrange error. Parameter value is larger than range permits.	Improper user operation of one of the ENTRY keys	Section III: Key Descriptions and Operators Check
P1 Error	Material Temperature Sensor No. 1 error	Material Temperature Sensor No. 1 signal has exceeded ±1V range of 5508A A to D converter subsystem	10757 Isolation (Para 8-A-81)
P2 Error	Material Temperature Sensor No. 2 error	Material Temperature Sensor No. 2 signal has exceeded ±1V range of 5508A A to D converter subsystem	10757 Isolation (Para 8-A-81)
P3 Error	Material Temperature Sensor No. 3 error	Material Temperature Sensor No. 3 signal has exceeded ±1V range of 5508A A to D converter subsystem	10757 Isolation (Para 8-A-81)
PA Error	Beam path error	Signal error detected at Measurement Frequency Pulse Counter (P/O 5508A A3):	
SIGNAL: Indicator extinguished		Laser Beam attenuation	Check operating environment for temperature gradients or smoke in the path of the laser beam.
SIGNAL: Indicator extinguished		Measurement Optics, misalignment	5518A Isolation (Para 8-A-70)
SIGNAL: Indicator extinguished		Measurement Optics, beam attenuation	Section III: Optics Cleaning
SIGNAL: Indicator extinguished		Signal attenuation in laser measurement path	5518A Isolation (Para 8-A-70)
SIGNAL: Indicator extinguished		Measurement Optics, broken	5518A Isolation (Para 8-A-70)
SIGNAL: Indicator extinguished		Turret assembly not functioning properly	5518A Isolation (Para 8-A-70)

Table 8-A-5. Error Messages (Continued)

Error Message	Condition	Cause: Possible Fault Location	Troubleshooting
PA Error (Cont'd)			
SIGNAL: Indicator extinguished		5518A Measurement Receiver failure	5518A Isolation (Para 8-A-70)
SIGNAL: Indicator lighted		5508A Measurement Frequency Channel failure	5508A Isolation (Para 8-A-65) 5508A Trouble Isolation Procedures (Para 8-B-14)
Pr Error	Programming error (check user software in HP-IB controller).	Improper instruction received over HP-IB:	
		HP-IB controller software	Section III: HP-IB information
SL Error	Signal loss error	Signal Error detected at Measurement Frequency Receiver:	
SIGNAL: Indicator lighted (may flicker)		Excessive velocity or acceleration of measurement optics	5518A Isolation (Para 8-A-70)
SIGNAL: Indicator extinguished		5518 Measurement Receiver failure	5518A Isolation (Para 8-A-70) 5518 Trouble Isolation Procedures (Para 8-C-43)
SIGNAL: Indicator lighted		5508A Measurement Frequency Channel (P/O A3) failure	5508A Isolation 5508A Troubleshooting and Repair Procedures (Para 8-B-14)
Sr Error	Sample rate too high	Output data is being requested at a rate that is too fast for the 5508A:	
		HP-IB controller software	
SS Error	Failed part of 5508A power-up self test	Power-Up self test failure:	
		5508A ROM or READ/WRITE Memory Failure	5508A Isolation (Para 8-A-65) 5508A Trouble Isolation Procedures (Para 8-B-14)
Ur Error	Underrange error. Parameter value is smaller than range permits.	Improper use of one of the ENTRY keys	Section III: Key Descriptions and Operators Check

8-A-48. 10751A/B and 10757A/B/C Sensor Errors

8-A-49. The electrical failures that can cause measurement inaccuracies without causing error messages or other indications are certain failures in the Air Sensor and Material Temperature Sensors or the 5508A A to D converter subsystem. Otherwise, operator considerations as discussed in the 5528A User's Guide determine system accuracy. Proper air sensor operation can be verfied using the V.O.L key. Proper 10757A/B/C operation can be verified using the MATL TEMP key. See Section III. **SPECIFICATIONS** for temperature and pressure measurements can only be verified as outlined in the calibration procedures of Section IV. See the Isolation Procedures in this section for initial troubleshooting.

8-A-50. 10751A/B and 10757A/B/C Signal Characteristics

8-A-51. Temperature Measurements

8-A-52. The 10751A/B and the 10757A/B/C provide a voltage signal that decreases linearly with increasing temperature. The voltage signal is bipolar and centered (0 volts) at approximately 25°C (77°F). An error message is displayed by the 5508A if a temperature signal exceeds the ±1V range of the Analog-to-Digital converter. The temperature measurements require +15V and -15V supplies and +10 Vref from the 5508A to generate the temperature signals. Note that the temperature sensors are calibrated for 0 to 40°C operation which does not require the full ±1 Volt range of the A to D.

8-A-53. Pressure Measurement

8-A-54. The 10751A/B also measures air pressure. The air pressure signal is also a D.C. Voltage that decreases linearly with increasing air pressure. An error message is displayed by the 5508A if the air pressure signals exceed ±1 Volt. +10 Vref is not used for the air pressure measurement, the 10751A/B pressure measurement requires only the +15V and -15V power supplies.

8-A-55. Humidity Switch

8-A-56. The humidity switch is used to send 1 of 3 voltages to the 5508A:

Switch Setting	Voltage
75%	0.7V (approx)
50%	0.0V
25%	-0.7V (approx)

8-A-57. Unused 10757A/B/C and 10751A/B Connectors

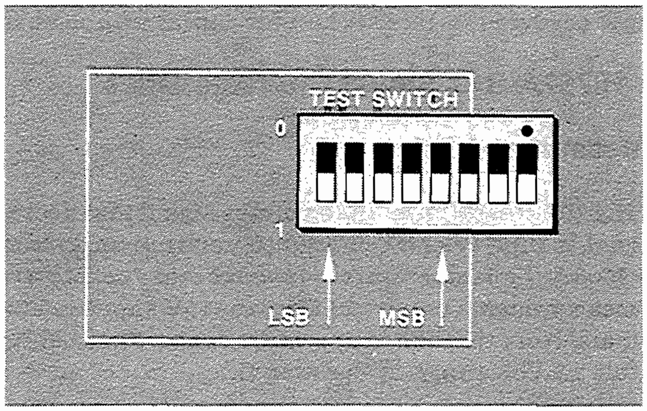
8-A-58. Connectors are provided on the rear panel for the 10757A/B/C and 10751A/B. When connectors are not used, the corresponding A to D input channels pull themselves up to approximately 2.5 Volts. Any input channel voltage greater than 1.6 Volts is interpreted by the 5508A as unused. The 10751A/B uses 3 input channels and each 10757A/B/C uses one. If any of the 3 10751A/B input channels is interpreted as unused, the 10751A/B is ignored by the 5508A.

8-A-59. 5508A Keyboard and Front Panel Display

8-A-60. Normal operation of the front panel keyboard and display can be verified according to the Key Descriptions and Operator's Check in Section III. The 5508A can be operated independent of the rest of the system for front panel checkout. See Paragraph 8-A-65, 5508A Isolation. The display uses 10 numeric display indicators and 5 red LED indicators which are all socket mounted. Bad indicators can be isolated by removing the front panel display filter and interchanging them.

8-A-61. Power-Up Failures

8-A-62. If the 5508A does not turn on properly as indicated by self test completion and warm-up countdown, repeat turn on after switching A.C. power off and removing all instrument cables from the rear panel connectors. Initial check information is provided in Paragraph 8-A-83, Power Supplies Troubleshooting to verify the power supplies. Also, check that A2S3 is set for normal operation as shown below:

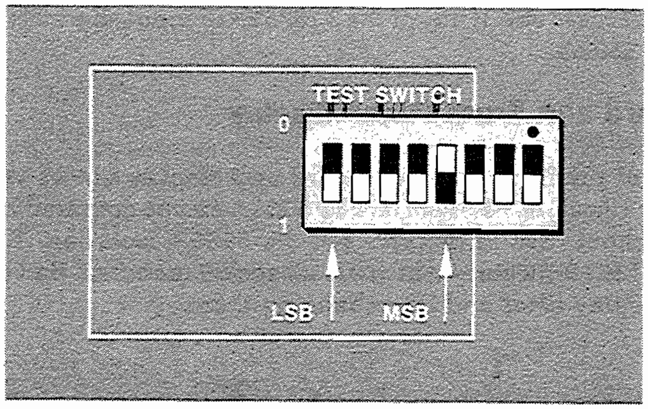


8-A-63. No Laser Light

8-A-64. If laser light is not emitted from the 5518A within one minute of turn on, check for proper positioning of the straightness mount and exit shutter. Check the +15VH power supply according to Paragraph 8-A-83, Power Supply Troubleshooting. If the +15VH supply checks OK, see the Laser/High Voltage Troubleshooting Procedure in Section VIII-C.

8-A-65. 5508A Isolation

8-A-66. The 5508A can simulate measurement and reference frequency input signals to allow the instrument to be run without the 5518A Laser Head attached. This simulation mode can be used to isolate Measurement or Reference Frequency Signal problems. Measurement frequency signal problems (error message is PA Error or SL Error) can be caused by the the 5508A, 5518A, or the Measurement Optics. Reference Frequency Signal problems (error message is LASr FAIL or HD Error) can be caused by the 5518A or 5508A. The simulation mode is also useful for checking out 10751A/B or 10757A/B/C operation without the Laser Head attached to the 5508A. To run the 5508A in the laser simulation mode, loosen the Pozidrive screw on the rear of the top cover and slide the top cover rearward. Configure A2S3, TEST SWITCH, as shown below:



8-A-67. The 5508A reads the test switch value only at power-up. Alternatively, A2S2 (MASTER RESET), can be toggled to start the simulation mode after A2S3 has been set accordingly. In the laser simulation mode, the 5508A displays 0.0000 mm (or 0.00000 in), the BEAM STRENGTH meter reads zero and all front panel keys operate normally. To resume normal operation, reset the test switch to 00000000 and toggle MASTER RESET.

8-A-68. Beam Strength Meter Test

8-A-69. The beam strength meter and meter drive circuitry in the 5508A can also be tested in this mode. To perform the test connect a 5 k Ohm resistor between pin A (BEAM STRENGTH) of the LASER SOURCE connector, A4J8, and chassis ground. BEAM STRENGTH deflection should be approximately 50% when the resistor is connected. This test is an initial test for 5508A circuitry only. In order to verify the adjustment of the Beam Strength Signal the Laser Power Output Test and Receiver Gain Test in Section IV should be performed.

8-A-70. 5518A Isolation

8-A-71. The 5518A Isolation Procedures are provided to help isolate problems encountered during a measurement. If the 5518A does not warm-up properly (error message is LASr FAIL) or a Reference Frequency Signal problem should occur (error message is Hd Error) the 5518A Troubleshooting and Repair Procedures in Section VIII-C will generally be required.

8-A-72. Measurement errors (error message is PA Error or SL Error) can be caused by the 5518A, the 5508A, or the Measurement Optics. These errors can also be caused by improper use or application of the measurement system. The 5528A User's Guide should be used to verify proper operator procedures in cases of intermittent or occasional problems.

8-A-73. Straightness Measurements

8-A-74. To verify proper 5518A performance in STRAIGHTNESS mode, first check the turret assembly and the Measurement Optics:

a. Check that the 5518A Turret Assembly and Exit Shutter are configured properly for Straightness.

b. Are the Measurement Optics properly aligned according to the 5528A User's Guide?

c. If the conditions in a. and b. are apparently satisfied and the Straightness Measurement cannot be performed, the 5518A can be isolated as follows:

    1. Perform the Laser Power Output Test in Section IV.

    2. Check the Measurement Receiver and Straightness Gain Switch with the following procedure. This procedure should be performed only after the Laser Power Output Test has been sucessfully completed.

        a. Set the 5518A Turret Assembly to STRAIGHTNESS. Position a 10773A Flatness Mirror at a maximum distance of 6 inches from the Turret Assembly. Align the return beam for maximum indication on the 5508A Beam Strength Meter.

        b. Maximum indication should be approximately 90% full scale, if not, perform the Receiver Gain Test in Section IV in order to isolate between the Measurement Receiver and Straightness Gain Switch.

8-A-75. Linear Measurements

8-A-76. The Laser Output Test and Receiver Gain Test in Section IV can be used to verify 5518A operation for linear measurements. The Laser Power Output Test should be performed before the Receiver Gain Test.

8-A-77. Angular/Flatness Measurements

8-A-78. 5518A operation can be verifed for Angular/Flatness Measurements as described in paragraph 8-A-75, Linear Measurements. Also, proper system operation using Linear Measurement Optics, if available, can be used to isolate problems to the Angular Measurement Optics or their use.

8-A-79. 10751A/B Isolation

8-A-80. Air Sensor measurement failures can be isolated using the following procedure. Failures can be caused by either the 5508A or the 10751A/B. If the Air Sensor is attached to the 5508A and none of its measurements can be displayed using the V.O.L. key then one of the three signals (air temperature, air pressure, or relative humidity) has exceeded 1.7 Volts. Otherwise the faulty signal can be identified using the V.O.L. key. See the key description in Section III.

a. Disconnect the Air Sensor from the 5508A and verify the open connector resistances and voltages at the 5508A rear panel connectors according to Paragraph 8-A-91, Connectors and Cables.

b. If the connector checks out O.K., the failure is probably located in the 10751A/B.

c. For additional confidence in the 5508A Air Sensor connector and the three associated A to D converter input channels, perform the following. Note that this test does not verify the accuracy of the A to D converter to the level required by the system. It is only designed to isolate gross errors or failures. To verify A to D converter accuracy first calibrate the unit according to Section IV, then see the A to D accuracy test procedure in Section VIIIB if required.

   1. Ground pins A, G, and H of the Air Sensor connector on the 5508A rear panel.

   2. Set the English/Metric switch on the 5508A Rear Panel to Metric.

   3. Air Sensor data should be displayed by the 5508A in response to the V.O.L. key as follows:

Air Temperature	25.36°C ±0.4°C
Air Pressure	760.2 ±3.5 mm Hg
Relative Humidity	50%

NOTE

Good contact is required at the connector pins for this test. The connector pins are 0.04″ in diameter and require a test probe of this size for the test. Alternatively the A to D converter input channels can be grounded at A3R56. See Figure 8-B-2, A3 Counter Board, Sheet 4.

8-A-81. 10757A/B/C Isolation

8-A-82. Material temperature measurement failures can be isolated using the following procedures. Failures can be caused by either the 5508A or the 10757A/B/C.

a. If a Material Temperature Sensor works on one but not all of the rear panel connectors, the failure is in the corresponding A to D converter input channel.

b. Disconnect the individual Material Temperature Sensors and verify the open connector resistances and voltages at the 5508A rear panel connector as described in Paragraph 8-A-91, Connectors and Cables.

c. If the connector pins check out and the sensor does not work properly on any of the Material Temperature Sensor connectors on the 5508A rear panel, the failure is probably located in the 10757A/B/C.

d. For additional confidence in the 5508A Material Temperature Sensor connectors and corresponding A to D converter input channels, perform the following test. Note that this test does not verify the accuracy of the A to D converter to the level required by the system. It is only designed to isolate gross errors or failures. To verify A to D converter accuracy first calibrate the unit according to Section IV, then see the A to D accuracy test procedure in Section VIII-B if required.

    1. Ground pin F of the open connector in question. This simulates a temperature signal corresponding to approximately 25°C.

    2. Set the English/Metric switch on the 5508A Rear Panel to Metric.

    3. Press MATL TEMP to verify the A to D converter and input channel. The temperature displayed by the 5508A for the corresponding input channel should be 25.36°C ±0.4°C.

NOTE

Good contact is required at the connector pin for this test. The connector pins are 0.04" in diameter and require a test probe of this size for the test. Alternatively the A to D converter input channels can be grounded at A3R56. See Figure 8-B-21, A3 Counter Board, Sheet 4.

8-A-83. Power Supply Troubleshooting

8-A-84. Initial checks can be performed on system power supplies by disconnecting all instruments from the 5508A and making measurements on the rear panel connector pins. See Paragraph 8-A-91, Connectors and Cables. 5508A internal indicators (located on A5 Power Supply Board) provide visual indication of power supply status. See Paragraph 8-A-41 for indicator locations and information for 5508A internal access. The 5508A supplies operating power for all system instruments. Table 8-A-6, Power Supplies shows supplies used by each instrument. Note that certain supplies share fuses.

Table 8-A-6. Power Supplies

Supply	Where Used	Fuse
Line Voltage 110/115/220/240V	5508A	5508A F1 (Line Fuse)
+15VH	5518A	5508A F1, A5F2, 5518A F1
+15V	5508A 10751A/B 10757A/B/C	5508A F1
-15V	5518A 10751A/B 10757A/B/C	5508A F1
+5V	5508A	5508A F1 A5F1

8-A-85. 5508A Primary Power

8-A-86. The 5508A chassis (earth) ground can be checked according to Paragraph 8-20, Before and After Service Product Safety Checks. Primary power wiring is shown on Figure 8-B-32, A5 Power Supply. The 5508A must be configured for the available A.C. line voltage according to Paragraph 2-8 Line Voltage and Fuse Selection.

8-A-87. 5518A Power

8-A-88. The 5508A +15VH and -15V supplies are used by the 5518A. There is a +15VH fuse in the 5518A on A1. +15VH powers the Laser High Voltage Power Supply. The 5518A derives +5V from the +15VH for logic circuitry power.+15VH is also used with the -15V for bipolar supply requirements in the 5518A. To verify 5518A power supplies, turn power off and remove the 5518A cover. A1S1 disables the +15VH input to the High Voltage Power Supply when the cover is removed. To re-enable the High Voltage Supply, set A1S2 to TEST. See Warnings and Cautions on page 8-3. The output of the High Voltage Power Supply should only be checked according to the Laser/High Voltage Power Supply Troubleshooting in Section VIII-C.

8-A-89. Instrument Current Requirements

8-A-90. Nominal current requirements of the 5508A, 5518A, 10751A/B, and 10757A/B/C are listed below for each power supply. Note that the +5V and +15VH supplies use remote sensing. These nominal current values should be used for indication only.

Supply	5508A	5518A	10751A/B	10757A/B/C
+5V	3.5A	Not Used	Not Used	Not Used
+15V	30 mA	Not Used	70 mA	20 mA
-15V	25 mA	17 mA (max*) 11 mA (typ*)	70 mA	20 mA
+15VH	Not Used	2.5A (max*) 1.5A (typ*)	Not Used	Not Used

**Maximum value is value when laser heater is active, typical value is value with heater off.*

8-A-91. Connectors and Cables

8-A-92. 5508A rear panel connector pin-outs are shown in Figure 8-A-2, 5508A Connectors. Pin designation letters on the figure correspond to those stenciled on the connector. Pin designation letters are also stenciled on the cables that attach to the rear panel connector. Connector pin function and open connector measurement values are provided for reference in Tables 8-A-7 through 8-A-10, Connector Pinouts. Open connector (no instrument connected) measurement values listed in the table can be used for initial tests. Good probe contact is required to verify resistance measurements that are given for some of the connector pins. The cable pins are 0.04 inch in diameter.

8-A-93. An HP 3456A Digital Voltmeter is required for resistance and voltage measurements. For resistance measurements, be sure to zero the instrument to eliminate test lead resistance. Figure 8-B-22, A4 Rear Panel Connector Board and Figure 8-A-3, Signal Flow and Indicator Diagram can be used when tracing signal paths with the 5518A, 10751A/B, or 10757A/B/C connected to the 5508A.

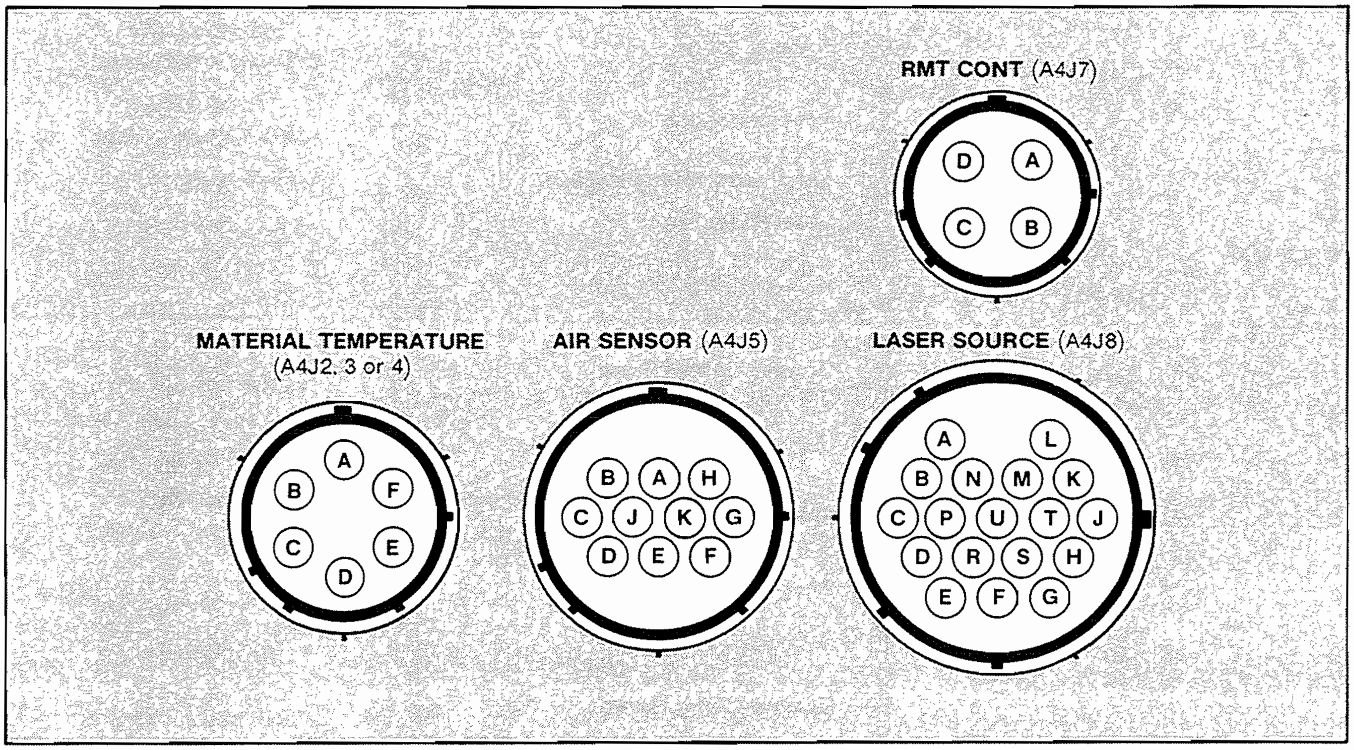


Figure 8-A-2. 5508A Connectors

Table 8-A-7. Remote Control Connector Pinouts

Connector	Pin	Function	Open Connector Measurement Values
Remote Control	A	Ground	0 to 1.5 mV
	B	External Reset	Approximately 5V (TTL Pullup)
	C	External Sample	Approximately 4V (TTL Pullup)
	D	Meter Drive	-100 to 100 mV (With 5518A disconnected)

Table 8-A-8. Laser Source Connector Pinouts

Connector	Pin	Function	Open Connector Measurement Values
Laser Source	A	Beam Strength	Approximately 5V
	B	Measurement Frequency Signal	80 to 90Ω (5508A Power Off)
	C	Measurement Frequency Signal	80 to 90Ω (5508A Power Off)
	D	Measurement Shield	0.02 to 0.2Ω
	E	Reference Frequency Signal	80 to 90Ω (5508A Power Off)
	F	Reference Frequency Signal	80 to 90Ω (5508A Power Off)
	G	Power Ground	0.02 to 0.2Ω (5508A Power Off)
	H	Power Ground	0.02 to 0.2Ω (5508A Power Off)
	J	+15V Head Remote Sense	14.5 to 15.5V
	K	+15V Head	14.5 to 16.0V
	L	-15V	-14.5 to -16V
	M	+15V Head	14.5 to 16.0V
	N	Ground-Cable Shield	0.02 to 0.2Ω (5508A Power Off)
	P	Ground-Cable Shield	0.02 to 0.2Ω (5508A Power Off)
	R	Reference Shield	0.02 to 0.2Ω (5508A Power Off)
	S	Power Ground	0.02 to 0.2Ω (5508A Power Off)
	T	+15V Head	14.5 to 16.0V
	U	Ground-Cable Shield	0.02 to 0.2Ω (5508A Power Off)

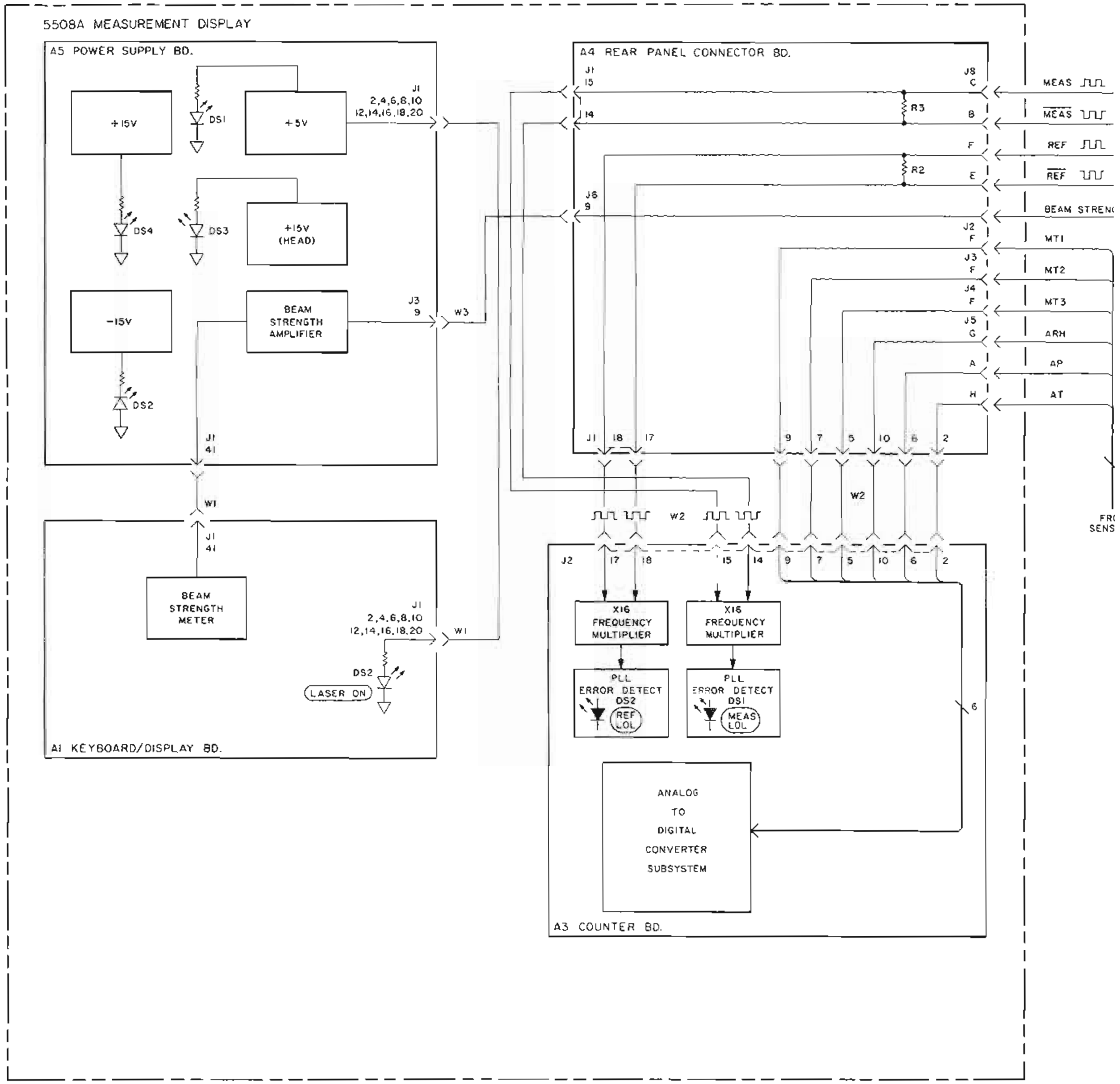
Table 8-A-9. Air Sensor Connector Pinouts

Connector	**Pin**	**Function**	**Open Connector Measurement Values**
Air	A	**Air Pressure Signal**	2 to 3V
	B	+10Vref	9.9 to 10.1V
	C	Cable Shield	0.02 to 0.2Ω (5508A Power Off)
	D	Analog Ground	0.02 to 0.3Ω (5508A Power Off)
	E	+15V	14.5 to 15.5V
	F	-15V	-14.5 to -15.5V
	G	**Humidity Switch Signal**	2 to 3V
	H	**Air Temperature Signal**	2 to 3V
	J	Ground-Cable Shield	0.02 to 0.2Ω (5508A Power Off)
	K	Not Used	

Table 8-A-10. Material Temperature Connector Pinouts

Connector	**Pin**	**Function**	**Open Connector Measurement Values**
Material Temperature	A	Cable Shield	0.02 to 0.2Ω (5508A Power Off)
	B	+10Vref	9.9 to 10.1V
	C	+15V	14.5 to 15.5V
	D	Analog Ground (Not used by 10757)	0.02 to 0.3Ω (5508A Power Off)
	E	-15V	-14.5 to -15.5V
	F	MTX	2 to 3V

**Measurement values with respect to chassis (earth) ground. Typical values or tolerances indicated by HP 3456A Voltmeter.*


5508A MEASUREMENT DISPLAY
A5 POWER SUPPLY BD.
+15V
DS1
+5V
J1
2,4,6,8,10
12,14,16,18,20
DS4
DS3
+15V (HEAD)
-15V
BEAM STRENGTH AMPLIFIER
J3
9
W3
DS2
J1
41
W1
J1
41
BEAM STRENGTH METER
J1
2,4,6,8,10
12,14,16,18,20
W1
DS2
LASER ON
A1 KEYBOARD/DISPLAY BD.
A4 REAR PANEL CONNECTOR BD.
J1
15
14
J6
9
R3
R2
J8
C
B
F
E
J2
F
J3
F
J4
F
J5
G
A
H
MEAS
MEAS
REF
REF
BEAM STRENG
MT1
MT2
MT3
ARH
AP
AT
FR
SENS
J1
18
17
9
7
5
10
6
2
W2
W2
J2
17
18
15
14
9
7
5
10
6
2
X16 FREQUENCY MULTIPLIER
X16 FREQUENCY MULTIPLIER
PLL ERROR DETECT DS2
REF LOL
PLL ERROR DETECT DS1
MEAS LOL
6
ANALOG TO DIGITAL CONVERTER SUBSYSTEM
A3 COUNTER BD.

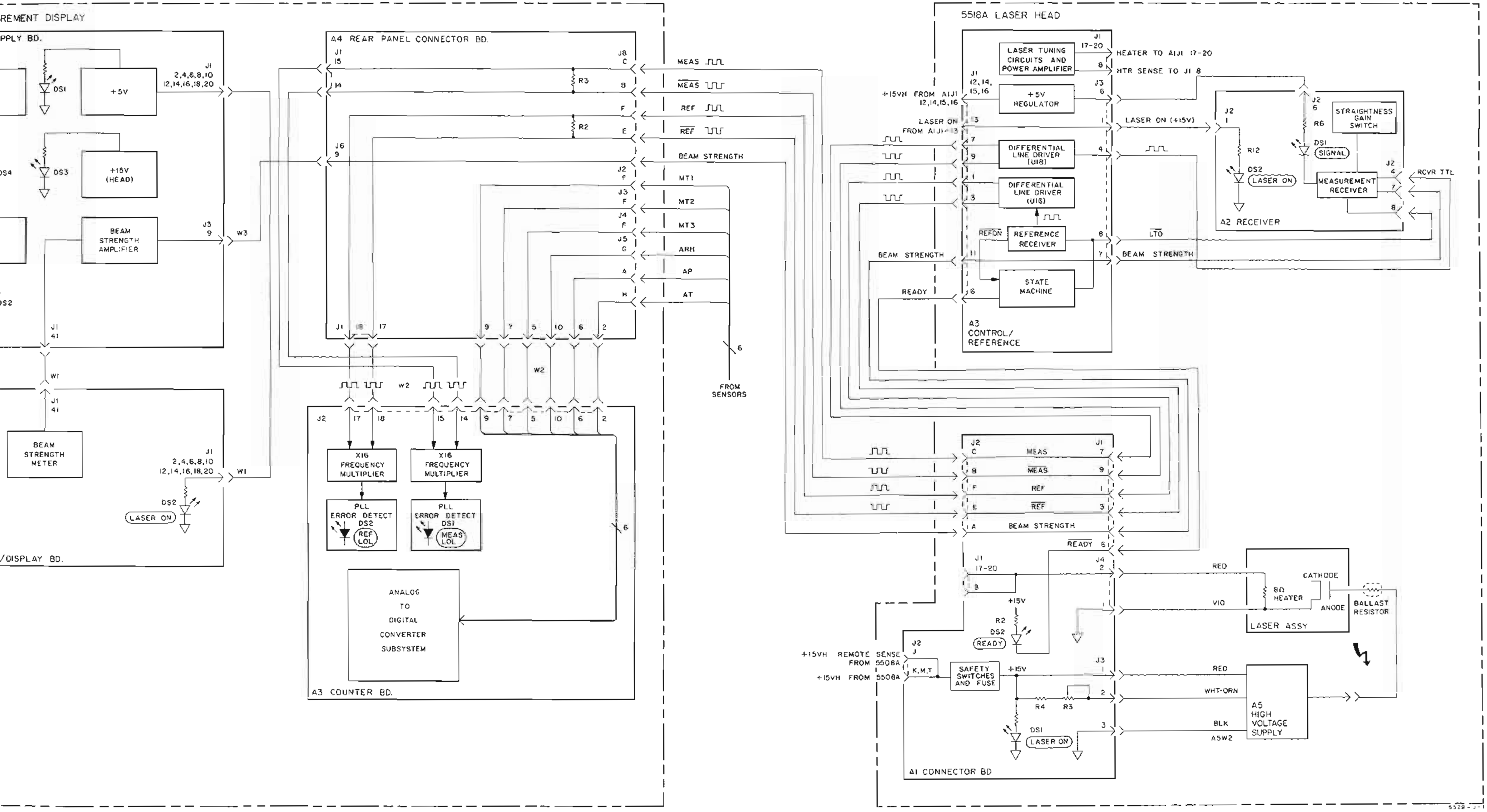

REMENT DISPLAY
PPLY BD.
DS1
+5V
J1
2,4,6,8,10
12,14,16,18,20
DS4
DS3
+15V
(HEAD)
BEAM
STRENGTH
AMPLIFIER
J3
9
W3
DS2
J1
41
W1
J1
41
BEAM
STRENGTH
METER
J1
2,4,6,8,10
12,14,16,18,20
W1
DS2
LASER ON
/DISPLAY BD.
A4 REAR PANEL CONNECTOR BD.
J1
15
14
J8
C
R3
B
F
R2
E
J6
9
J2
F
J3
F
J4
F
J5
G
A
H
J1
18
17
9
7
5
10
6
2
W2
w2
MEAS
MEAS
REF
REF
BEAM STRENGTH
MT1
MT2
MT3
ARH
AP
AT
6
FROM
SENSORS
J2
17
18
15
14
9
7
5
10
6
2
X16
FREQUENCY
MULTIPLIER
X16
FREQUENCY
MULTIPLIER
PLL
ERROR DETECT
DS2
REF
LOL
PLL
ERROR DETECT
DS1
MEAS
LOL
6
ANALOG
TO
DIGITAL
CONVERTER
SUBSYSTEM
A3 COUNTER BD.
5518A LASER HEAD
LASER TUNING
CIRCUITS AND
POWER AMPLIFIER
J1
17-20
8
HEATER TO A1J1 17-20
HTR SENSE TO J1 8
J1
12,14,
15,16
+15VH FROM A1J1
12,14,15,16
+5V
REGULATOR
J3
6
LASER ON
FROM A1J1-13
3
1
LASER ON (+15V)
7
9
1
3
DIFFERENTIAL
LINE DRIVER
(U18)
4
DIFFERENTIAL
LINE DRIVER
(U16)
REFON
REFERENCE
RECEIVER
8
LTO
BEAM STRENGTH
11
7
BEAM STRENGTH
READY
6
STATE
MACHINE
A3
CONTROL/
REFERENCE
J2
1
R12
DS2
LASER ON
J2
6
R6
DS1
SIGNAL
STRAIGHTNESS
GAIN
SWITCH
J2
4
RCVR TTL
MEASUREMENT
RECEIVER
7
8
A2 RECEIVER
J2
C
MEAS
B
MEAS
F
REF
E
REF
A
BEAM STRENGTH
J1
7
9
1
3
READY 6
J1
17-20
8
J4
2
1
RED
VIO
8Ω
HEATER
CATHODE
ANODE
BALLAST
RESISTOR
LASER ASSY
+15V
R2
DS2
READY
+15VH REMOTE SENSE
FROM 5508A
+15VH FROM 5508A
J2
J
K,M,T
SAFETY
SWITCHES
AND FUSE
+15V
J3
1
2
3
R4
R3
DS1
LASER ON
RED
WHT-ORN
BLK
A5W2
A5
HIGH
VOLTAGE
SUPPLY
A1 CONNECTOR BD
5528-J-1

Figure 8-A-3. 5528A Signal Connection and Indicator Diagram

Figure 8-A-3
5528A SIGNAL CONNECTION AND INDICATOR DIAGRAM

(See Page 8-A-23)

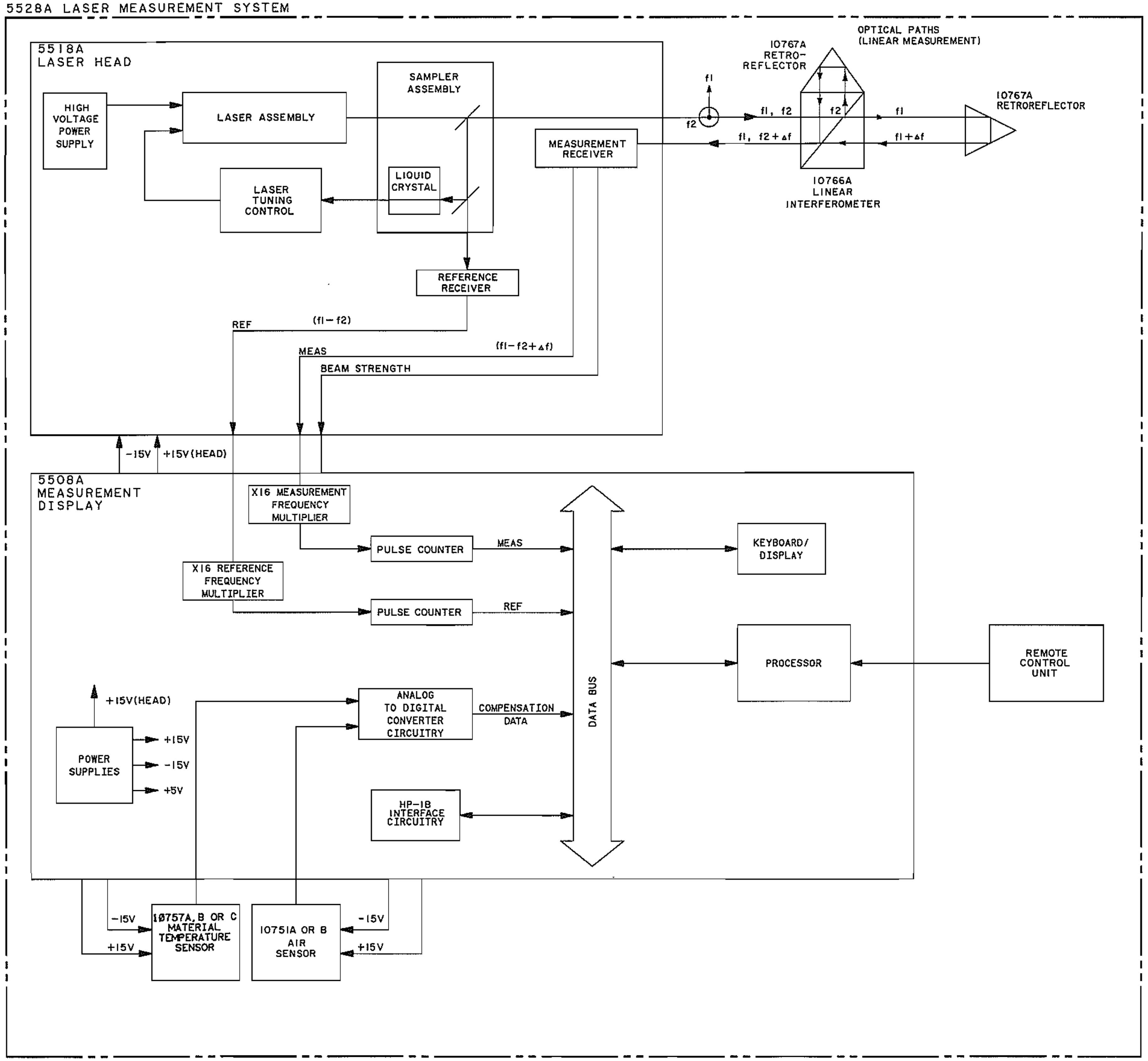

5528A LASER MEASUREMENT SYSTEM
5518A LASER HEAD
HIGH VOLTAGE POWER SUPPLY
LASER ASSEMBLY
SAMPLER ASSEMBLY
LIQUID CRYSTAL
LASER TUNING CONTROL
MEASUREMENT RECEIVER
REFERENCE RECEIVER
REF
(f1 − f2)
MEAS
(f1 − f2 + Δf)
BEAM STRENGTH
f1
f2
f1, f2
f1, f2 + Δf
10767A RETRO-REFLECTOR
OPTICAL PATHS (LINEAR MEASUREMENT)
f2
f1
f1 + Δf
10767A RETROREFLECTOR
10766A LINEAR INTERFEROMETER
−15V
+15V (HEAD)
5508A MEASUREMENT DISPLAY
X16 MEASUREMENT FREQUENCY MULTIPLIER
X16 REFERENCE FREQUENCY MULTIPLIER
PULSE COUNTER
MEAS
PULSE COUNTER
REF
KEYBOARD/ DISPLAY
PROCESSOR
REMOTE CONTROL UNIT
DATA BUS
+15V (HEAD)
POWER SUPPLIES
+15V
−15V
+5V
ANALOG TO DIGITAL CONVERTER CIRCUITRY
COMPENSATION DATA
HP-IB INTERFACE CIRCUITRY
−15V
+15V
10757A, B OR C MATERIAL TEMPERATURE SENSOR
10751A OR B AIR SENSOR
−15V
+15V

Figure 8-A-4. 5528A System Block Diagram

Figure 8-A-

5528A SYSTEM BLOCK DIAGRA

(See Page 8-A-25

SECTION VIII-B
5508A MEASUREMENT DISPLAY

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SECTION VIII-B
5508A MEASUREMENT DISPLAY

8-B-1. 5508A MEASUREMENT DISPLAY BLOCK DIAGRAM DESCRIPTION

8-B-2. Paragraphs 8-B-3 through 8-B-13 contain the block diagram description for the 5508A Measurement Display. Paragraphs 8-B-14 through 8-B-30 cover the trouble isolation procedures which are designed to isolate problems to the board or functonal area.

8-B-3. The block diagram for the 5508A Measurement Display is shown in Figure 8-B-3. The 5508A is a microprocessor based instrument composed of the following major circuit boards assemblies.

A1 Keyboard/Display Board 05508-60001

A2 Processor Board 05508-60002

A3 Counter Board 05508-60003

A4 Rear Panel Connector Board 05508-60004

A5 Power Supply Board 05508-60005

8-B-4. A2 Processor Board and A3 Counter Board

8-B-5. The microprocessor unit (MPU) is the heart of the system and functions as a controller for the pulse counters, the A/D converter, the HP-IB, and the keyboard/display assembly. The MPU controls the sequence of operations for the various modes and units selected, including transfer and routing of data, calculations, and display functions.

8-B-6. The laser head output signals, Reference and Measurement, connect to the 5508A via Rear Panel Connector Board A4 for routing to their respective channels on Counter board A3. In order to extend the resolutuion of the measurement, phase lock loops on A3 multiply the frequency of the Reference and Measurement signals by 16 before they are routed to pulse counters.

8-B-7. When either counter is half full, the MPU is interrupted to read the value in each counter. These two values are subtracted and stored, yielding a difference count which is proportional to the displacement in the optical measurement path. Each successive difference count adds to the previous one in RAM. The MPU then performs the necessary computations to give the displacement in either english or metric units.

8-B-8. Before displaying a measurement, the processor weights the difference of the pulse counters according to the measurement mode. For the weight (value) of each count in straightness or angular modes, the 5508A uses constants stored in ROM. For a distance measurement, however, the 5508A requires a constant and a compensation number.

8-B-9. If the Measurement Signal is interrupted, for example when the optical path is broken, the 5508A displays "PA ERROR". Similiarly, "HEAD ERROR" appears on the display if the reference channel is interrupted.

8-B-10. If the frequency of the Measurement Signal exceeds the range of the phase locked loops (i.e., less than 500 kHz or greater than 4 MHz), a loss of lock error occurs. The display will show "SL ERROR" if the error occurred in the Measurement Channel and "HD ERROR" for Reference Channel errors.

8-B-11. The A/D converter receives six analog inputs including air pressure, air temperature, humidity, and the three material temperatures. Upon conversion of an analog input to digital form, the converter interrupts the MPU. Upon interrupt, the MPU responds by reading the digital values and using them for compensation calculations. Compensation is made for the speed of light in air and the thermal expansion of the material being measured.

8-B-12. A1 Keyboard/Display Board

8-B-13. When a front panel key is pressed, the keyboard interrupts the MPU which in turn scans the keyboard switch matrix to determine which key was pressed. The processor then executes the proper routine and outputs data to the display drivers whenever a new calculation has been made.

8-B-14. 5508A MEASUREMENT DISPLAY TROUBLE ISOLATION

8-B-15. The following paragraphs contain descriptions of the 5508A indicators that are useful for trouble isolation, preliminary checks, symptoms and probable causes, an internal switch summary, and assembly removal instructions.

8-B-16. 5508A Indicators

LASER ON Indicator. Monitors the 5508A +15 Volt power supply line. Designed to alert the operator that the 5518A Laser Head is activated and emitting a beam.

BEAM STRENGTH Meter. Indicates the relative strength of the laser beam measurement signal. The meter reading can be used to aid in optimizing the optical alignment of the laser and measurement optics. Beam strength indications within the green area of the meter are required for proper operation.

8-B-17. 5508A Self Test

8-B-18. Extensive self-tests are built into the 5508A and are exercised upon power-up. Immediately after power is applied, the 5508A performs a checkerboard RAM test, followed by a ROM checksum. The checksum routine is similiar to a signature analysis algorithm, using a feedback register technique. This test is performed on the contents of the 16K program ROM. If the RAM or ROM tests fail, an SS Error is displayed by the 5508A. If the 5508A passes this test, the front panel is excercised followed by testing of the counter sections.

8-B-19. The first counter test begins by switching the Processor Board's 1 MHz clock into the reference channel phase-locked loops. The counter is cleared and a short time delay is generated in software. During this delay, an exact number of known counts should accumulate in the reference channel. Since the clock signal is the same signal that is used to generate the software time delay, the exact frequency of the clock is not critical; a delay equal to a particular number of system clock cycles should always produce the same number of pulses counted. A second time delay is generated, yielding another value in the counters, this one is the binary complement of the first. Thus both binary states in each bit of the reference channel are checked. If the 5508A passes this test, the message PASS 1 is displayed. A failure produces the message FAIL 1 and the 5508A can not be configured for a measurement until the problem is resolved.

8-B-20. The second counter test is similiar to the first, except the measurement channel is verified, rather than the reference channel. Either PASS 2 or FAIL 2 is displayed.

8-B-21. The third self-test involves the counters in a free-running mode. Once again the microprocessor system clock is used as the counter inputs, emulating the laser reference and measurement signals. The counters are allowed to run free for a longer delay, during which time they interrupt 150 times. Since both channels have the same input (the system clock), they should always have the same number of counts, plus or minus one for jitter. If interrupts do not occur 150 times in 0.5 second, or if there is a net number of counts (i.e., one channel is counting more than the other) the message FAIL 3 appears. FAIL messages must be resolved before a measurement can be taken.

8-B-22. The last self-test on power-up involves the Analog Subsystem. During this test, the 0.5V reference and analog ground are converted to digital form and read. Since the A to D Converter is a ratiometric device, the exact value of the 0.5 V reference doesn't matter. The test only checks the activity of the A to D Converter and the existence of the reference. If either of the two conversions fails to agree with predetermined values or if the A to D Converter doesn't generate an interrupt in the time allotted, then the unit displays FAIL 4. Otherwise PASS 4 is displayed and the test continues.

8-B-23. Next, the 5508A displays the values of the two digital calibration switches, one for the 10 V reference and the other for the 0.5 V reference. Finally, the HP-IB address switch value is displayed before the warm-up countdown starts.

8-B-24. Preliminary Checks

a. Check that the following cables are connected correctly. Remove the cable from the connectors and reset them firmly to remove any dirt or oxidation from the pins.

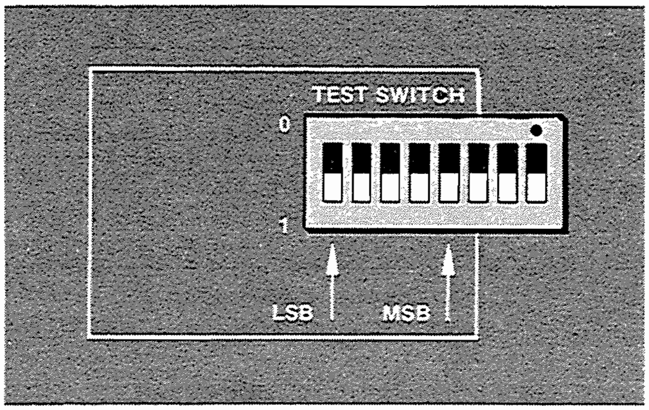
   1. Check Cable W1. It should connect from the processor board to the counter board, the power supply, and the keyboard.
   2. Check Cable W2. It should connect from the processor board to the counter board, and then split into two sections. One of the sections routes to the HP-IB connector, the other section goes to the rear panel board.
   3. Check Cable W3. It should go from the power supply board to the rear panel.

b. Check DIP switches and jumpers on the processor board and counter board as follows:

A1 (05508-60001): None

A2 (05508-60002):

TEST SWITCH A2S3:- all zeroes (toward "dot") as shown below:



Jumper JMP1 - NORM.
Jumper JMP2 - installed.

A3 (05508-60003):

DIP switches - don't care - don't change
Jumper JMP1-5 all NORM (all face to the center of board)

A4 (05508-60004): None

A5 (05508-60005): None

c. Check line fuse in line module. Also check fuses on power supply board.

8-B-25. Symptoms and Probable Causes

8-B-26. Table 8-B-1 lists symptoms to choose from in the event the 5508A appears to be failing. This list supplements the system level troubleshooting information in Section 8A. In general, the information and tests of Section 8A should be used to isolate failures to the instrument level. If the 5508A is suspected of causing a failure that is not covered in Section 8A or the symptoms listed below, proceed through the 5508A troubleshooting procedures in the following order:

a. A5 Power Supply board

b. A2 Processor board

c. A1 Keyboard

d. A3 Counter board, counter circuits

e. A3 Counter board, analog to digital converter circuits

Table 8-B-1. 5508A Troubleshooting

Symptoms	Probable Cause/Troubleshooting
Fan doesn't run. No display	Power Supply A5. Go to Power Supply Troubleshooting Procedures, Paragraph 8-B-362.
Fan runs. No display or uninterpretable display.	Processor not responding. Check power supply for +15V, −15V, +15VH, and +5V LED's. If OK, go to A2 Processor Board Troubleshooting Procedures, Paragraph 8-B-73. If processor checkout procedures are OK, go to A1 Keyboard Troubleshooting Procedures, Paragraph 8-B-42.
SS error displayed	Failed RAM or ROM tests. Go to A2 Processor Board Troubleshooting Procedures, Paragraph 8-B-73.
FAIL 1 displayed during self-test	Failed Counter board test. Perform A3 Counter Section Troubleshooting Procedures, starting with Test 1, with emphasis on the reference channel (towards the rear of the unit). See Paragraph 8-B-167.
FAIL 2 displayed during self-test	Failed Counter board test. Perform A3 Counter Section Troubleshooting Procedures, starting with Test 1, with emphasis on measurement channel (towards the front of the unit). See Paragraph 8-B-167.
FAIL 3 displayed during self-test	Indicates one of two possible failures: Counter interrupt test or Counter free run test. Go to A3 Counter Section Troubleshooting Procedures starting with Test 1. Emphasize Tests 5 and 7 if the problem is not determined before then. See Paragraph 8-B-167.
FAIL 4 displayed during self-test	A to D Converter Failure: Indicates A to D Converter Failure. Go to Analog Subsystem Troubleshooting.
Jumps out of PASS 2, during self-test and display reads 0.0000.	Processor is going into interrupt when there is none. Go to A2 Processor Board Troubleshooting Procedures, with emphasis on Test 6 (interrupt encoder test). See Paragraph 8-B-73 and 8-B-89.
Self-test runs but hangs up, displays "PASS 3"	Check Cable W2 connection at A4J2, A3J2 and A2J2.
5508A fails to respond to front panel key inputs.	Keyboard interrupt circuitry. Go to A1 Keyboard Troubleshooting Procedures, Paragraph 8-B-42, then to A2 Processor Board Test 6, Paragraph 8-B-73, and 8-B-89.

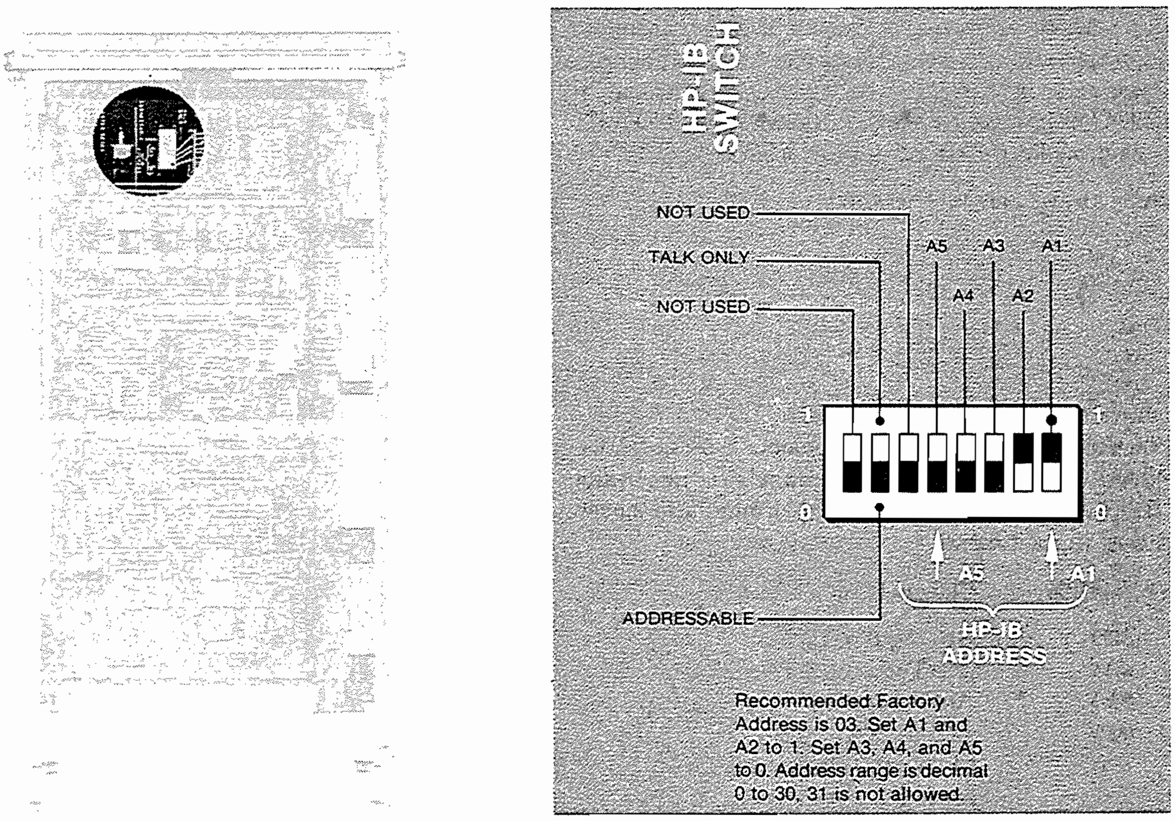
Table 8-B-1. 5508A Troubleshooting (Continued)

Symptoms	Probable Cause/Troubleshooting
5508A fails to respond to External Reset or Record	Use A3 Counter Board Troubleshooting Procedures, Paragraph 8-B-167.
Display digit stuck on or off, or segment stuck on or off or annunciator stuck on or off	LEDs or drivers. Go to A1 Keyboard Troubleshooting Procedures, Paragraph 8-B-42.
CAL A (when displayed at Power-Up) is the wrong number	Check A3U58. Use A3 Analog Subsystem Troublehooting Procedures, Paragraph 8-B-267.
CAL B (when displayed at Power-Up) is the wrong number	Check A3U62. Use A3 Analog Subsytem Troublehooting Procedures. See Paragraph 8-B-267.
ADDR is the wrong number when displayed at Power-Up	Check inputs to A2U3. Use A2 Processor Board Troubleshooting Procedures. See Paragraph 8-B-73.
NOTE: The compensation number is not updated when it is being read on the display.	

8-B-27. 5508A Internal Switch Summary

A2S1. Sets the HP-IB ADDRESS and the TALK-ONLY ADDRESSABLE function. When set to TALK ONLY, the 5508A can only output data to the HP-IB. In ADDRESSABLE, the 5508A functions as a Talker and Listener under the control of an HP-IB Controller.

Switch shown to set 5508A to Addressable and device address 03.

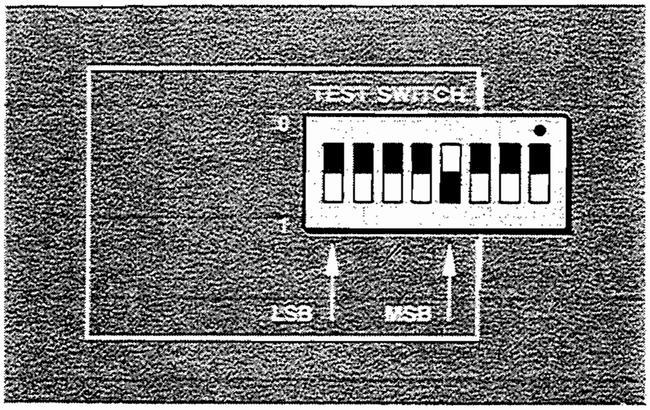


Recommended Factory Address is 03. Set A1 and A2 to 1. Set A3, A4, and A5 to 0. Address range is decimal 0 to 30. 31 is not allowed.

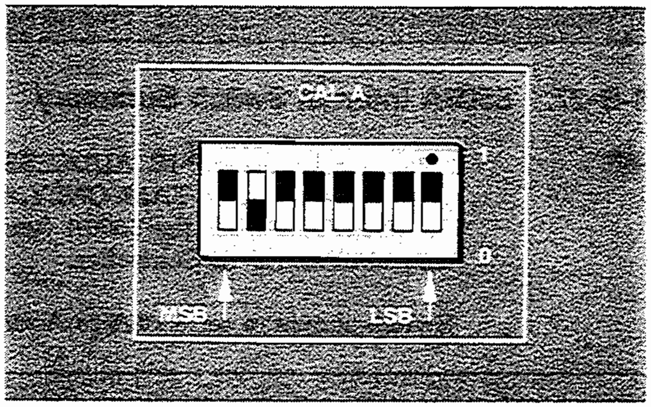
Figure 8-B-1. 5508A HP-IB Switch

A2S2 MASTER RESET. Resets the 5508A, giving the same results as turning AC power off then back on.

A2S3 TEST SWITCH. Enables various troubleshooting modes of the 5508A. Read by the MPU only at power-up or after MASTER RESET. To use, set to appropriate test and push MASTER RESET. Note that the least significant bit (LSB) of the switch is toward the front of the 5508A. For normal operation, set to all zeroes.

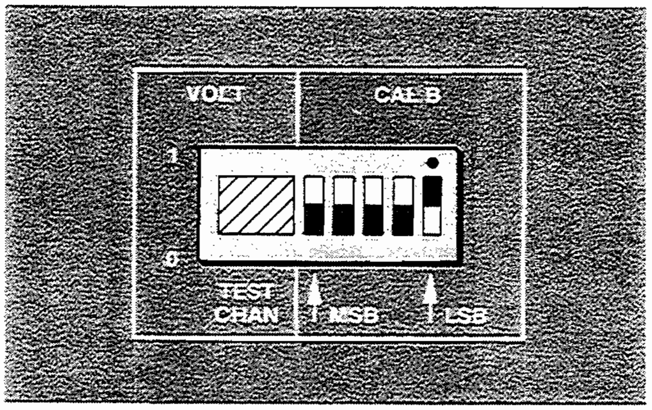


A3S1 CAL A. Change only during 5508A calibration or troubleshooting. Used to set the true value of the voltage reference, +10 Vref, for the MPU. Read by the MPU only at power-up or after MASTER RESET. See Section IV for calibration procedures.



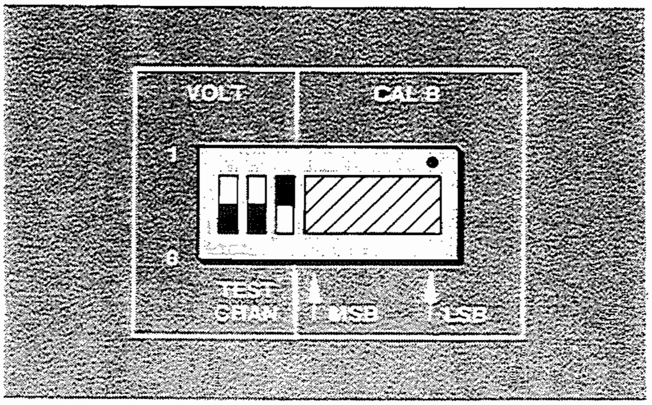
A3S2 CAL B. Change only during 5508A calibration or troubleshooting. Used to set the true value of the voltage reference, +0.5 Vref, for the MPU. Read by the MPU only at power-up or after MASTER RESET. See Section IV for calibration procedures.

Switch shown set to 1 (00001)



A3S2 Voltmeter Test Channel Select. 3-bits of A3S2 are used to select 1 of 8 input channels to the Analog to Digital Converter. Switch positions and correponding input channels are as follows:

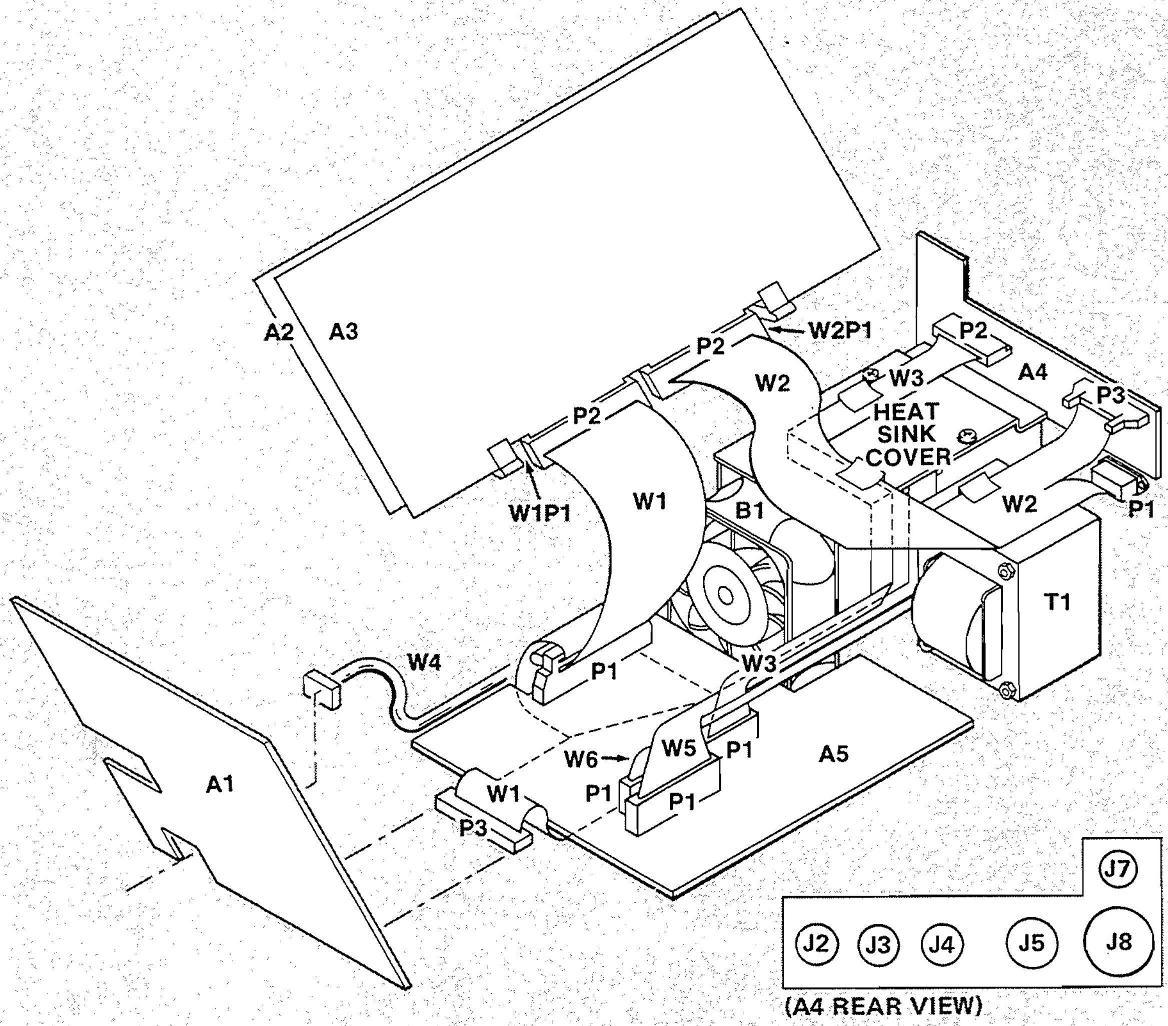
Test Switch	Channel
000	Analog Ground
001	Air Temperature
010	Air Pressure
011	Air Humidity
100	Material Temperature 1
101	Material Temperature 2
110	Material Temperature 3
111	+0.5 Vref



8-B-28. 5508A Assembly Removal Instructions

8-B-29. Figure 8-B-2 shows the 5508A assembly locations and cable designations.

8-B-30. The exploded view diagrams in Section VI provide access/removal information as well as assembly part number references.


A2
A3
W2P1
P2
P2
A4
P3
W2
W3
HEAT SINK COVER
P2
W1P1
W1
B1
W2
P1
T1
W4
P1
W3
A1
W6
W5
P1
A5
W1
P1
P1
P3
J7
J2
J3
J4
J5
J8
(A4 REAR VIEW)

Reference Designator	Description
A1	Keyboard/Display Board Assembly
A2	Processor Board Assembly
A3	Counter Board Assembly
A4	Rear Panel Connector Board Assembly
A5	Power Supply Board Assembly
W1	Control Cable Assembly
W2	Analog/HP-IB Cable Assembly
W3	Laser Cable Assembly
W4	Power Switch Cable Assembly
W5	Heat Sink Cable Assembly
W6	P/O Transformer
T1	Transformer
B1	Fan

Figure 8-B-2. 5508A Assembly and Cable Designations

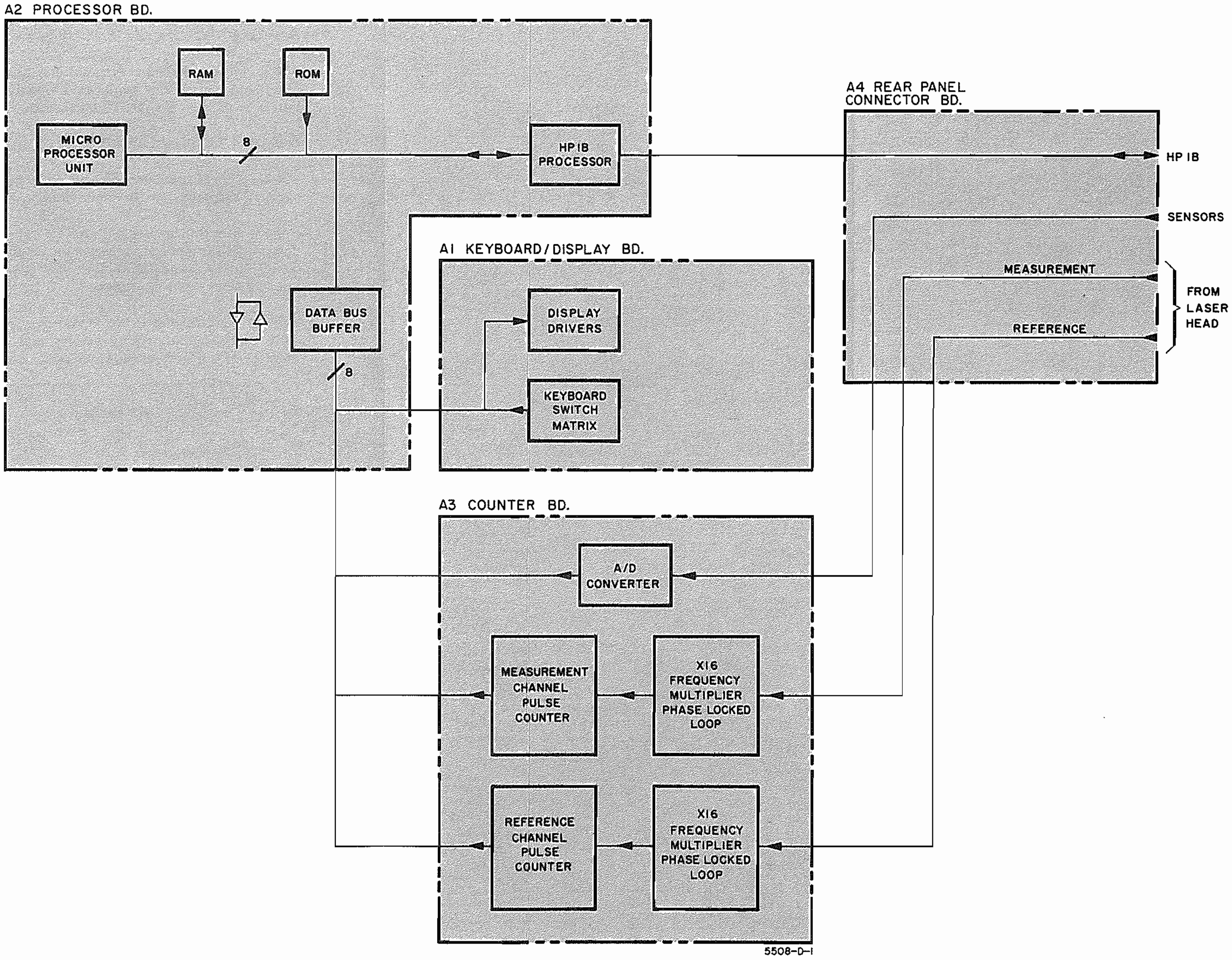

A2 PROCESSOR BD.
RAM
ROM
MICRO PROCESSOR UNIT
8
HP IB PROCESSOR
DATA BUS BUFFER
8
A1 KEYBOARD/DISPLAY BD.
DISPLAY DRIVERS
KEYBOARD SWITCH MATRIX
A4 REAR PANEL CONNECTOR BD.
HP IB
SENSORS
MEASUREMENT
REFERENCE
FROM LASER HEAD
A3 COUNTER BD.
A/D CONVERTER
MEASUREMENT CHANNEL PULSE COUNTER
X16 FREQUENCY MULTIPLIER PHASE LOCKED LOOP
REFERENCE CHANNEL PULSE COUNTER
X16 FREQUENCY MULTIPLIER PHASE LOCKED LOOP
5508-D-1

Figure 8-B-3. 5508A Measurement Display Block Diagram

Figure 8-B-3

5508A MEASUREMENT DISPLAY BLOCK DIAGRAM

(See Page 8-B-9)

8-B-31. 5508A A1 KEYBOARD/DISPLAY CIRCUIT THEORY

8-B-32. Paragraphs 8-B-33 through 8-B-41 contain circuit theory for Keyboard/Display A1. Paragraphs 8-B-42 through 8-B-50 cover the troubleshooting and signature analysis information.

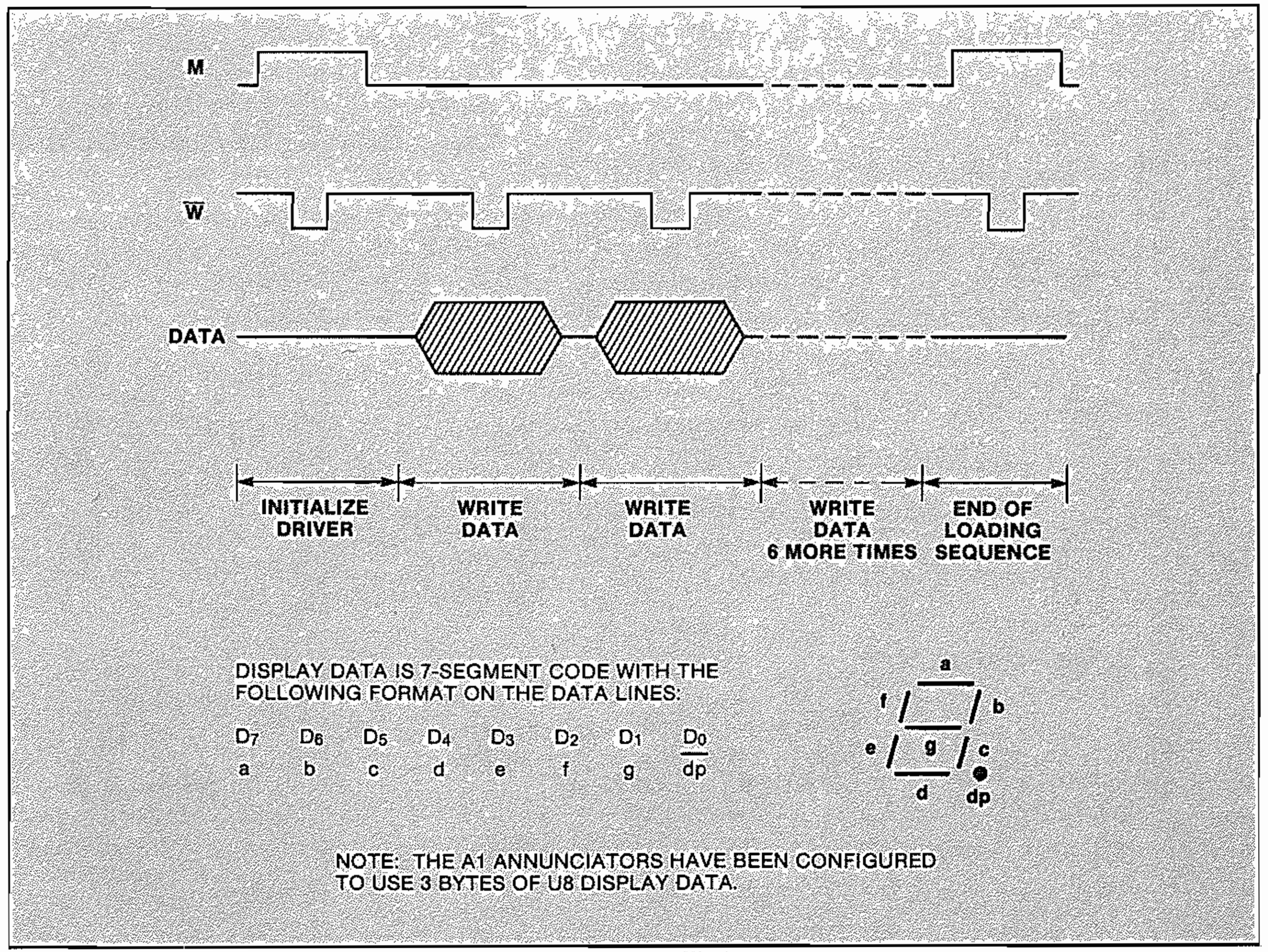
8-B-33. The schematic diagram for Keyboard/Display A1 is shown in Figure 8-B-5. The schematic has functional blocks that are labeled alphabetically with circled letters. These labels correspond to the circled letters in the text for the circuit theory.

8-B-34. Display Circuitry Ⓑ Ⓒ Ⓔ

8-B-35. The display section consists of control latches U5 and U6, display drivers U1 and U8, 10 LED seven-segment displays, and 10 annunciators.

8-B-36. Control latches U5 and U6 are used to write into the data display drivers U1 and U8. The MPU determines the mode of operation for U1 and U8 via U5 and the data is sent to the drivers via U6. Once the data is written into U1 and U8, further MPU control is not necessary since the data display drivers have their own internal clocks and multiplexers.

8-B-37. Each display driver is capable of driving eight 7-segment LED's (64 bits including decimal points). The drivers require that display data be loaded in a serial byte format, all eight bytes in a single operation. A timing diagram of the loading sequence is shown in Figure 8-B-4.



DISPLAY DATA IS 7-SEGMENT CODE WITH THE FOLLOWING FORMAT ON THE DATA LINES:

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
a	b	c	d	e	f	g	dp

NOTE: THE A1 ANNUNCIATORS HAVE BEEN CONFIGURED TO USE 3 BYTES OF U8 DISPLAY DATA.

Figure 8-B-4. 5508A A1 Timing Diagram

8-B-38. Some annunciators are double driven to double the duty cycle and increase the intensity of the annunciators.

8-B-39. Keyboard Scanning and Interrupt Circuitry Ⓑ Ⓓ Ⓕ

8-B-40. During normal operation, a closure of any key on the keyboard switch matrix generates an MPU interrupt signal via $\overline{\text{IN5}}$. Prior to a key closure, U10 pins 2, 5, 12, and 15 are low. If any key is closed, causing a low on its column, the output of U9 goes high and $\overline{\text{IN5}}$ goes true via U3B. When responding to a keyboard interrupt, the MPU first clears U3. The column of the key closure is determined by latching and reading the inputs of U7. The rows are then enabled one at a time by cycling a low through the outputs of U10. U7 is synchronously latched and read to determine the row of the closure.

8-B-41. The MPU must be able to differentiate an "up-key" interrupt from a "down-key" interrupt. An up key interrupt does not cause a low to be latched by U7 as described above and therefore is easily determined. Up-key interrupts are used to complete keyboard input functions. For example, when manually loading the material temperature, the MATL TEMP key is pressed after the desired value has been entered. The MPU responds to the closure by displaying the entered value. When the MATL TEMP key is released, the MPU recognizes the key interrupt and begins operation in the selected measurement mode. U3A drives $\overline{\text{IN5}}$ low for up-key interrupts.

8-B-42. 5508A A1 KEYBOARD/DISPLAY TROUBLESHOOTING

8-B-43. The following troubleshooting procedures require the HP 5005A Signature Multimeter. All A1 components, except LED's and the LED Drivers, can be checked using the A1 signature analysis procedure. During execution of this procedure, the MPU exercises the keyboard control, bi-directional data, and the interrupt circuitry. Note that the display does not update during this test.

8-B-44. Initial Checks for A1 Problems

a. No response to a key closure

  1. An MPU Interrupt signal should result from a closure of any of the front panel keys regardless of the 5508A operating mode. Use a logic probe and check for a transition of the keyboard interrupt line at A2U12 pin 2 while pushing the suspected key.

  2. If no interrupt signal is observed - perform A1 signature analysis procedure.

  3. If an interrupt signal is observed - go to processor troubleshooting procedure in paragraph 8-B-73.

b. LED Problems

  1. All 7 segment LED's and Annunciators DS13, DS16, DS19, and DS20 are mounted in sockets and can be checked easily by interchanging them.

8-B-45. Troubleshooting Tips

8-B-46. Before testing the signatures, verify that the 5 Volt test signature is proper to ensure that the desired program is running. Where appropriate, signal paths leading to a node that gives an incorrect signature should be traced back until a correct signature is found. The faulty node should then be apparent and if the bad component is not obvious, current tracing or other techniques will be required. The integrity of traces attached to a bad node should always be verfied before any components are replaced. Whenever a correct signature is the last one given along a signal path, verify that all traces leading from that node are also OK.

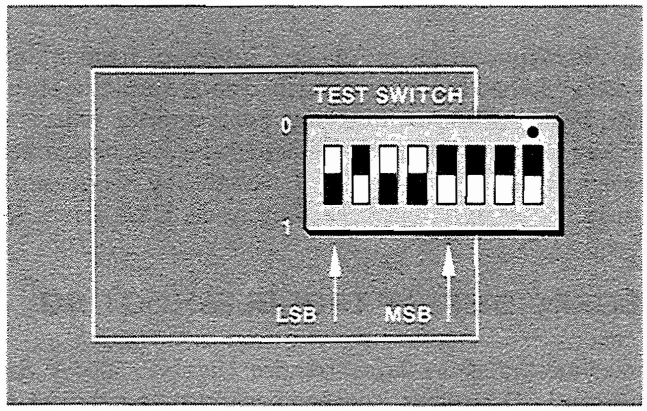
8-B-47. IC's are identified by etched numbers corresponding to the schematic reference designators. These numbers appear on both sides of the board next to pin 1 of the IC. Pin 1 is also identified by the "H" shaped soldering pad visible from both sides of the board.

8-B-48. If the signature analysis procedure for A1 does not isolate a problem that affects the display portion of the board and all LED's are functional, then a bad LED driver may be indicated. Use the schematic to determine the faulty driver. Note that a failure of the drivers may not be identified by signature analysis since the procedure indicates a problem only if the failure is a short to Vcc or ground of a driver input or output.

8-B-49. Signature Analysis Procedure

8-B-50. To perform the procedure refer to the schematic diagram, Figure 8-B-5 and proceed as follows:

a. Set switches on processor board A2 as follows:



JMP 1: NORM
JMP 2: INSTALLED

b. Set Signature Analyzer controls and connect test leads as follows:

CLOCK: Clock lead to CLOCK test point on processor board

START: Start lead to START test point on processor board

STOP: Stop lead to STOP test point on processor board

c. To measure the signatures, toggle MASTER RESET switch and check the following nodes:

1. +5 V Test Signature = FU21
   Ground Test Signature = 0000

2. Interrupt Signal Circuit

   U4 pin 13: PP28 If this signature is correct make sure that it is also present at A2U12 pin 2.

   U3 pin 1: AU95
   pin 3: 77C8 **
   pin 4: PP28
   pin 5: 2109
   pin 9: 2109
   pin 10: PP28
   pin 11: C899**

   U9 pin 8: C899 **
   U9 all inputs: FU21

   ** = with RESET key

3. Control Lines. If the control line signatures are incorrect, go to the processor board troubleshooting procedure (test 3). Verify that an incorrect control line signature is not caused by the A1 board. This can be checked by disconnecting Cable W1 and rechecking the control line signatures at A2U19.

U5 pin 1: HFPU

U4 pin 4: U7A8
pin 5: 3889
pin 9: U7A8

U6 pin 1: PH58

U2 pin 1: 0000
pin 3: FU21
pin 4: 0000

U10 pin 1: 0C6P

4. Data Bus Lines. Incorrect data bus signatures can be caused by drivers or receivers. A problem with the processor board bus driver, A2U4, can be isolated using test 5 of the processor board troubleshooting procedure. Data bus components on A1 require a current tracing procedure or component replacement if an incorrect signature occurs and the processor board bus driver checks OK.

U7 pin 2: HH19
pin 5: 223F
pin 6: 4A0C
pin 9: P178
pin 12: 0918
pin 15: 10U5
pin 16: 26U5
pin 19: 9PC6

5. Key Matrix Scan Lines. If the data bus signatures are correct, these signatures can be used to check U10 operation.

U10 pin 2: 7PHA
pin 5: 1206
pin 7: 7856
pin 10: AU95
pin 12: 77C8
pin 15: H016

6. Key Matrix Output Lines

All Key Matrix Outputs (U7 Inputs): FU21

The following signatures should be observed while pressing and holding the indicated key. These signatures are used to verify that the major keys make closures and U7 and U9 inputs are not stuck high.

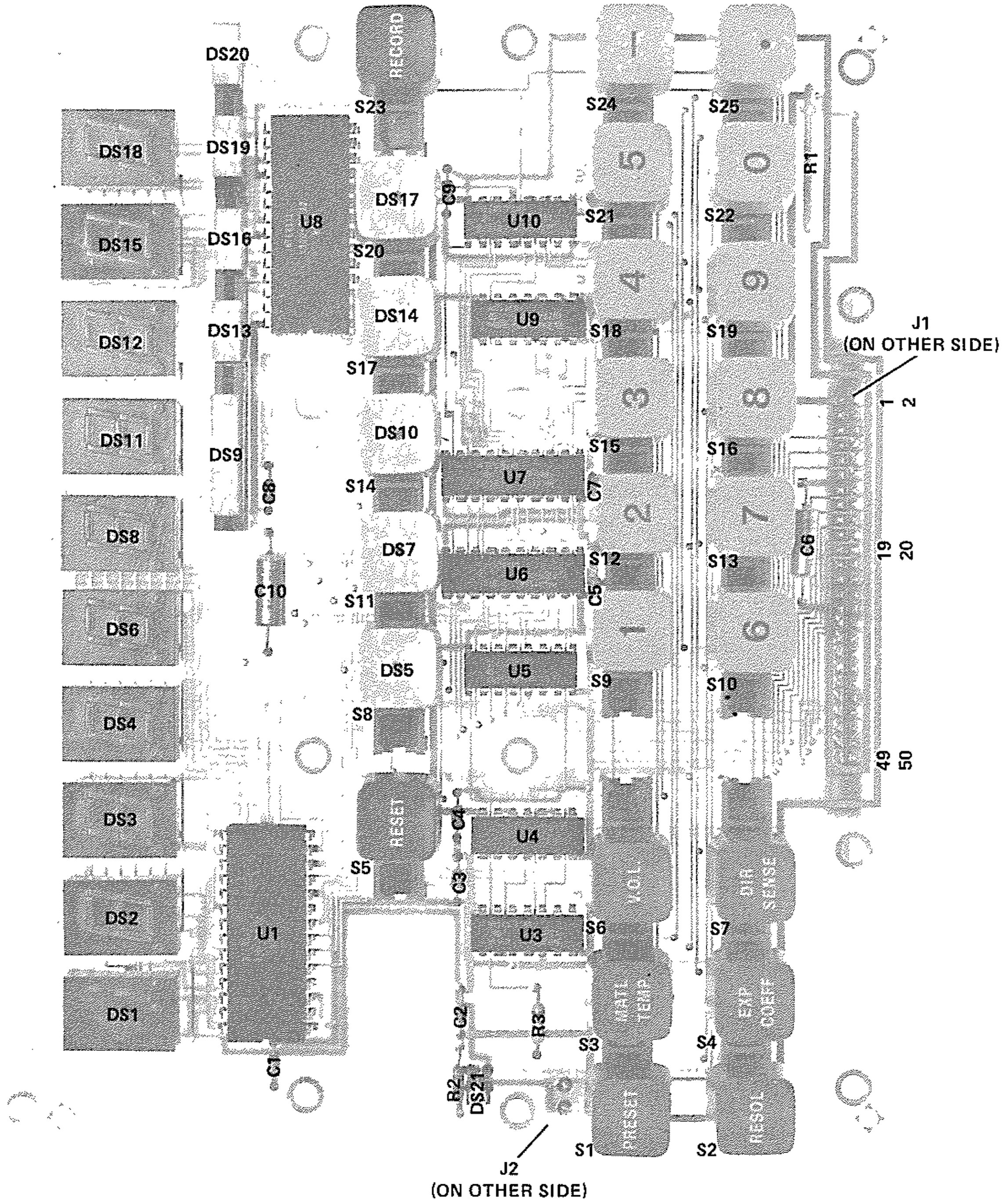
U4 pin 1:	77C8	RESET KEY
	1206	DISTANCE KEY
	1206	VELOCITY KEY
	1206	ANGLE KEY
	1206	LONG STRAIGHTNESS KEY
	1206	SHORT STRAIGHTNESS KEY
	77C8	PRESET KEY
	77C8	RESOL KEY

7. LED Driver Control Lines

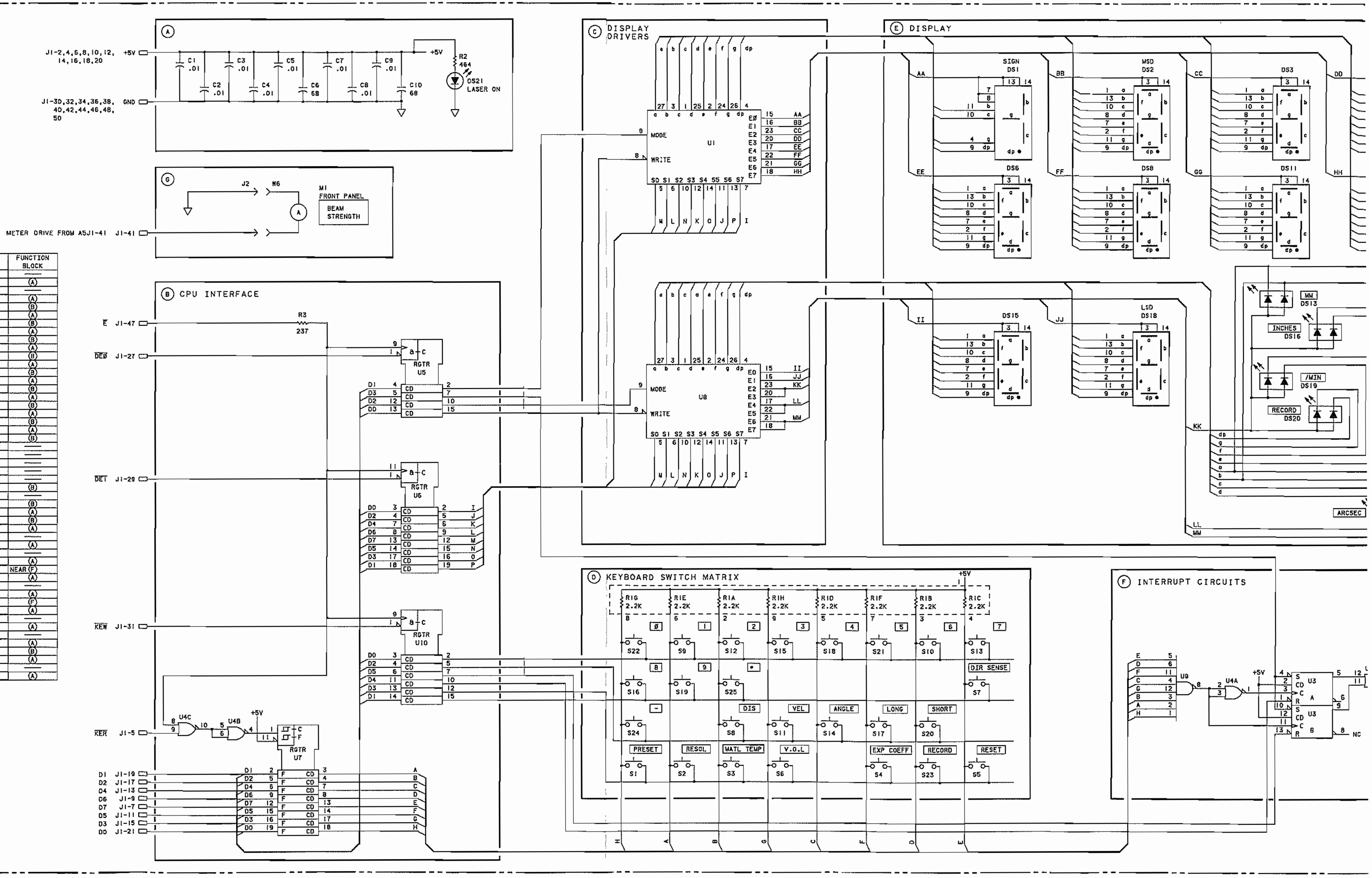
U5 pin 2: O5CH
pin 7: PP28
pin 10: 818U
pin 15: C692

8. LED Driver Data Lines

U6 pin 2: U6H2
pin 5: 9031
pin 6: 7FAH
pin 9: O466
pin 12: 2PF8
pin 15: F2C3
pin 16: CHF5
pin 17: 26U5

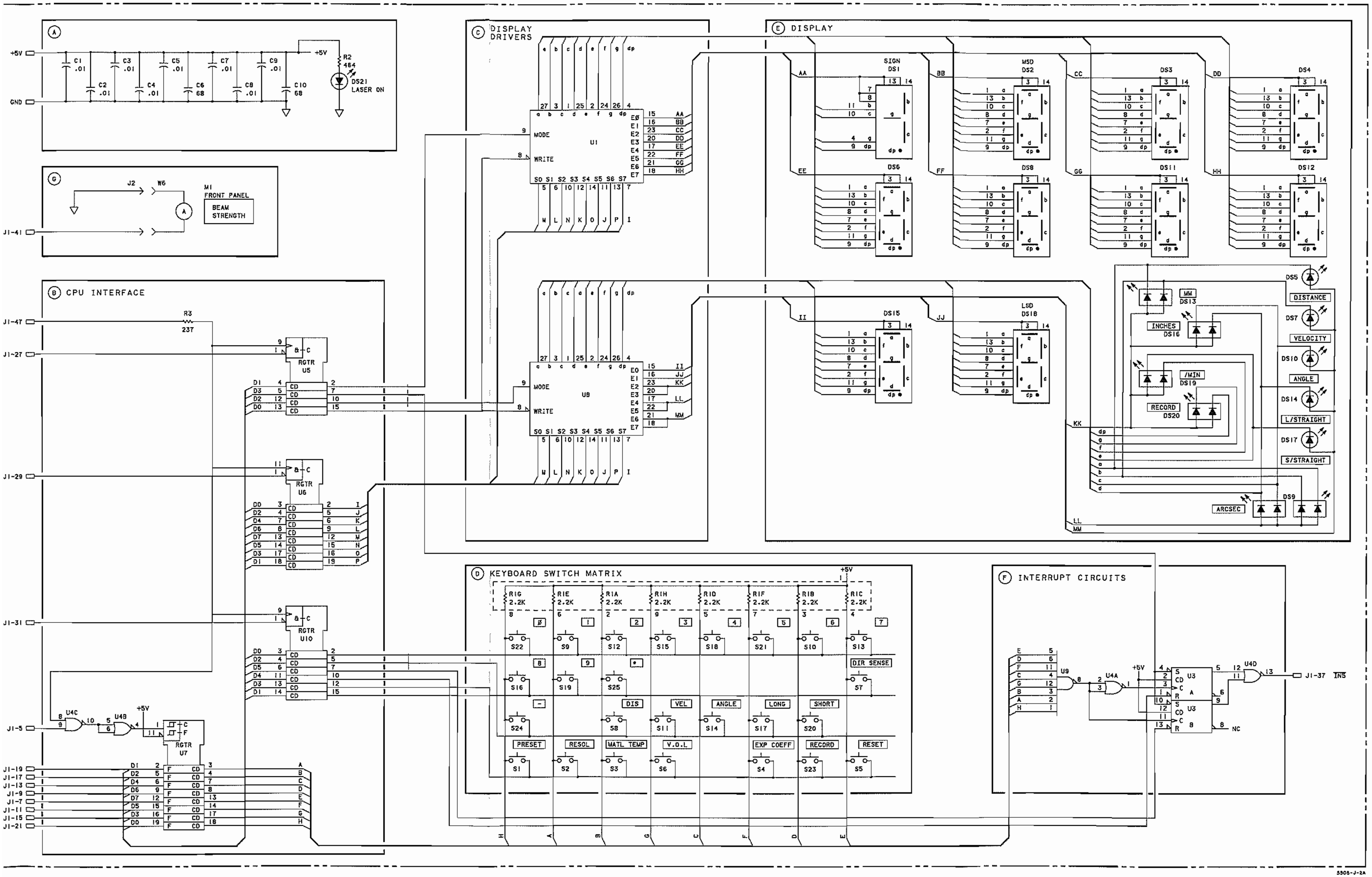

DS20
RECORD
S23
S24
S25
DS18
DS19
U8
5
0
R1
DS17
C9
U10
S21
S22
DS15
DS16
S20
4
9
DS14
U9
S18
S19
J1
(ON OTHER SIDE)
DS12
DS13
S17
3
8
1
2
DS11
DS10
S15
S16
DS9
C8
U7
C7
S14
2
7
DS8
DS7
U6
S12
S13
C6
19
20
C10
S11
C5
DS6
1
6
DS5
U5
S9
S10
DS4
S8
49
50
RESET
C4
U4
DS3
S5
C3
V.O.L.
DIR SENSE
DS2
U1
U3
S6
S7
MATL TEMP
EXP COEFF
DS1
C2
R3
S3
S4
C1
R2
DS21
PRESET
RESOL
S1
S2
J2
(ON OTHER SIDE)

A1 05508 KEYBOARD DISPLAY (005508-60001) SERIES 2216


Ⓐ
J1-2,4,6,8,10,12, 14,16,18,20 +5V
J1-30,32,34,36,38, 40,42,44,46,48, 50 GND
C1 .01
C2 .01
C3 .01
C4 .01
C5 .01
C6 68
C7 .01
C8 .01
C9 .01
C10 68
R2 464
DS21 LASER ON
Ⓖ
J2
W6
M1 FRONT PANEL
BEAM STRENGTH
METER DRIVE FROM A5J1-41 J1-41
Ⓑ CPU INTERFACE
E J1-47
R3 237
DE0 J1-27
DE1 J1-29
KEW J1-31
KER J1-5
RGTR U5
RGTR U6
RGTR U10
RGTR U7
U4C
U4B
D1 J1-19
D2 J1-17
D4 J1-13
D6 J1-9
D7 J1-7
D5 J1-11
D3 J1-15
D0 J1-21
Ⓒ DISPLAY DRIVERS
U1
U8
MODE
WRITE
Ⓔ DISPLAY
SIGN DS1
MSD DS2
DS3
DS6
DS8
DS11
DS15
LSD DS18
MM DS13
INCHES DS16
/MIN DS19
RECORD DS20
ARCSEC
Ⓓ KEYBOARD SWITCH MATRIX
R1G 2.2K
R1E 2.2K
R1A 2.2K
R1H 2.2K
R1D 2.2K
R1F 2.2K
R1B 2.2K
R1C 2.2K
0
1
2
3
4
5
6
7
8
9
•
−
DIR SENSE
DIS
VEL
ANGLE
LONG
SHORT
PRESET
RESOL
MATL TEMP
V.O.L
EXP COEFF
RECORD
RESET
Ⓕ INTERRUPT CIRCUITS
U9
U4A
U3
NC

A1J1 PIN	SIGNAL	TO/FROM VIA CABLE 1	FUNCTION BLOCK
1	NC	———	———
2	+5V	FROM A5J1-2	Ⓐ
3	NC	———	———
4	+5V	FROM A5J1-4	Ⓐ
5	$\overline{\text{KER}}$	FROM A2J1-5	Ⓑ
6	+5V	FROM A2J1-6	Ⓐ
7	D7	TO/FROM A2J1-7	Ⓑ
8	+5V	FROM A5J1-8	Ⓐ
9	D6	TO/FROM A2J1-9	Ⓑ
10	+5V	FROM A5J1-10	Ⓐ
11	D5	TO/FROM A2J1-11	Ⓑ
12	+5V	FROM A5J1-12	Ⓐ
13	D4	TO/FROM A2J1-13	Ⓑ
14	+5V	FROM A5J1-14	Ⓐ
15	D3	TO/FROM A2J1-15	Ⓑ
16	+5V	FROM A5J1-16	Ⓐ
17	D2	TO/FROM A2J1-17	Ⓑ
18	+5V	FROM A5J1-18	Ⓐ
19	D1	TO/FROM A2J1-19	Ⓑ
20	+5V	FROM A5J1-20	Ⓐ
21	D0	TO/FROM A2J1-21	Ⓑ
22	NC	———	———
23	NC	———	———
24	NC	———	———
25	NC	———	———
26	NC	———	———
27	$\overline{\text{DE0}}$	FROM A2J1-27	Ⓑ
28	NC	———	———
29	$\overline{\text{DE1}}$	FROM A2J1-29	Ⓑ
30	GND	FROM A5J1-30	Ⓐ
31	$\overline{\text{KEW}}$	FROM A2J1-31	Ⓑ
32	GND	FROM A5J1-32	Ⓐ
33	NC	———	———
34	GND	FROM A5J1-34	Ⓐ
35	NC	———	———
36	GND	FROM A5J1-36	Ⓐ
37	IN5	TO A2J1-37	NEAR Ⓕ
38	GND	FROM A5J1-38	Ⓐ
39	NC	———	———
40	GND	FROM A5J1-40	Ⓐ
41	METER DRIVE	FROM A5J1-41	Ⓕ
42	GND	FROM A5J1-42	Ⓐ
43	NC	———	———
44	GND	FROM A5J1-44	Ⓐ
45	NC	———	———
46	GND	FROM A5J1-46	Ⓐ
47	$\overline{\text{E}}$	FROM A2J1-47	Ⓑ
48	GND	FROM A5J1-48	Ⓐ
49	NC	———	———
50	GND	FROM A5J1-50	Ⓐ

Figu


A
+5V
GND
C1 .01
C2 .01
C3 .01
C4 .01
C5 .01
C6 68
C7 .01
C8 .01
C9 .01
C10 68
R2 464
DS21 LASER ON
G
J2
W6
M1 FRONT PANEL
BEAM STRENGTH
J1-41
B CPU INTERFACE
R3 237
J1-47
J1-27
RGTR U5
J1-29
RGTR U6
J1-31
RGTR U10
J1-5
U4C
U4B
RGTR U7
J1-19
J1-17
J1-13
J1-9
J1-7
J1-11
J1-15
J1-21
C DISPLAY DRIVERS
U1
U8
MODE
WRITE
E DISPLAY
SIGN DS1
MSD DS2
DS3
DS4
DS6
DS8
DS11
DS12
DS15
LSD DS18
DS5
DISTANCE
DS7
VELOCITY
DS10
ANGLE
DS14
L/STRAIGHT
DS17
S/STRAIGHT
DS9
ARCSEC
MM DS13
INCHES DS16
/MIN DS19
RECORD DS20
D KEYBOARD SWITCH MATRIX
R1G 2.2K
R1E 2.2K
R1A 2.2K
R1H 2.2K
R1D 2.2K
R1F 2.2K
R1B 2.2K
R1C 2.2K
0
1
2
3
4
5
6
7
8
9
•
-
DIR SENSE
DIS
VEL
ANGLE
LONG
SHORT
PRESET
RESOL
MATL TEMP
V.O.L
EXP COEFF
RECORD
RESET
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
S13
S14
S15
S16
S17
S18
S19
S20
S21
S22
S23
S24
S25
F INTERRUPT CIRCUITS
U9
U4A
U3
U4D
J1-37 INS
NC
5506-J-2A

NOTES:

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN FARADS;
   INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.

Reference Designations
C1-10
DS1-21
J1,2
R1-3
S1-25
U1, 3-10

Deleted: U2

TABLE OF ACTIVE ELEMENTS

Reference Desig.	HP Part No.	Mfr Part No.
U1, U8	1820-4686	ICM7481PI
U3	1820-1112	SN74LS74AN
U4	1820-1144	SN74LS02N
U5	1820-2244	SN74LS379N
U6	1820-1858	SN74LS377N
U7	1820-2102	SN74LS373N
U9	1820-0070	SN7430N
U10	1820-2056	SN74L378N

Figure 8-B-5. 5508A A1 Keyboard/Display Board 05508-60001

Figure 8-B-5

5508A A1 KEYBOARD/DISPLAY BOARD 05508-60001

(See Page 8-B-15)

8-B-51. 5508A A2 PROCESSOR BOARD CIRCUIT THEORY

8-B-52. Paragraphs 8-B-53 through 8-B-72 contain circuit theory for Processor Board A2. Paragraphs 8-B-73 through 8-B-109 cover the troubleshooting and signature analysis information.

8-B-53. The schematic diagram for Processor Board A2 is shown in Figure 8-B-18. The schematic has functional blocks that are labeled alphabetically with circled letters. These labels correspond to the circled letters in the text for the circuit theory.

8-B-54. Processor Ⓑ and English/Metric Switch Ⓖ

8-B-55. The heart of the Processor Board is U13, a type 6803 microprocessor unit (MPU). The MPU executes instructions stored in ROM based memory to control the counters, keyboard, displays, and analog to digital converter.

8-B-56. Crystal Y1 supplies 4 MHz to U13 pins 2 and 3. The MPU divides the 4 MHz by 4 to produce the system clock "E" at U13 pin 40. "E" is a 1 MHz square wave that synchronizes the timing throughout the 5508 except for the asynchronous counters.

8-B-57. Pins 13 thru 20 of the MPU are Input/Output port lines. In normal operation, pin 13 is set as an output, and the rest are all inputs. Pins 16 through 20 correspond to the TEST SWITCH positions and are only read at power up. Setting these switches to positions other than zeroes corresponds to different troubleshooting tests. Troubleshooting tests and corresponding switch positions are summarized in Table 8-B-2. Pin 14 of the MPU senses the position of the English/Metric switch, and Pin 13, as an output, initializes the English/Metric circuitry, U15.

8-B-58. Note that the MPU Input/Output port lines are programmed as either inputs or outputs during program execution and cannot be accessed. Consequently, if the MPU is not running properly, it is futile to check the logic polarity of the TEST SWITCH bits since a line expected to be a logic 1 input (5 volts) may be incorrectly programmed as a logic 0 output (0 volts). Rather, turn power off and use an ohmmeter to check the TEST SWITCH bits.

8-B-59. Master Reset Section Ⓒ

8-B-60. The Master Reset section generates $\overline{\text{RESET}}$ when the 5508A powers up or when the MASTER RESET switch on the front of the Processor Board is toggled. When $\overline{\text{RESET}}$ occurs, a low to high transition completely resets the MPU. Upon reset, U13 pins 8, 9, and 10 are at logic 0, 1, and 0 respectively to set the MPU to the initial start up configuration.

8-B-61. Priority Interrupt Ⓐ

8-B-62. Two types of interrupt signals are supplied to U13, an $\overline{\text{INTERRUPT REQUEST}}$, ($\overline{\text{IRQ}}$), and a $\overline{\text{NON MASKABLE}}$ interrupt ($\overline{\text{NMI}}$). $\overline{\text{NMI}}$ can be asserted (0 volts) by the Measurement or Reference Frequency Pulse Counters or the external Record button on the remote control box. IRQ originates from one of five sources:

a. HP-IB (U12 pin 13)

b. English/Metric switch (U12 pin 12)

c. Keyboard ($\overline{\text{IN5}}$)

d. Analog to Digital Converter ($\overline{\text{IN4}}$)

e. External Reset ($\overline{\text{IN7}}$)

8-B-63. When one of the five lines above goes low (0 volts), decoder U12 determines which of the 5 input lines was asserted. Note that three of the input lines to U12 are always tied high through pullup resistor pack R13. U12 outputs, pin 6, 7, and 9, provide a 3 bit number which the MPU reads to determine the source of an interrupt. The MPU reads this 3 bit result after $\overline{\text{IRQ}}$ goes low and proceeds to execute the proper interrupt service program.

8-B-64. ROM Ⓔ and RAM Ⓘ

8-B-65. The MPU outputs address information onto the address bus and either waits for data (a READ operation), or outputs data onto the data bus (a WRITE operation). The R/$\overline{\text{W}}$ line (U13 pin 38) is high for a read, and low for a write. ROMS U5, U6, U7, U8, and U9 contain the program memory, and the proper ROM is selected by U10 or U11B. U1 and U2 are RAM's (R/W memory) with U1 corresponding to the lower 4 bits of the data bus, and U2 the higher 4 bits. U20A selects these RAM's.

8-B-66. Data Bus Driver Ⓙ

8-B-67. U4 acts as a bidirectional data bus buffer to drive Cable W1. U4 is selected when a read or write operation is required off the Processor Board. For example, when the processor reads data from the counters, U4 on the counter board is used to buffer data from the cable to the processor.

8-B-68. Address Decode Section Ⓕ

8-B-69. U19, U21, and associated circuits generate the enable lines for circuitry located on other boards, i.e., lines that are required to enable registers (such as a counter or display). When one of these lines goes low, the processor either clocks data out to the peripheral, or waits for the peripheral to send data to the MPU.

8-B-70. U14 implements data bus/address bus multiplexing that is required by the MPU. MPU pins 30 through 37 are used by the MPU as data bits D0-D7 and address bits A0 through A7. Pin 39 of the MPU clocks U14 when A0 through A7 goes valid (falling edge of signal at pin 39).

8-B-71. HP-IB Circuits Ⓚ Ⓗ Ⓛ Ⓜ

8-B-72. HP-IB DIP switch S1 selects the HP-IB address. When enable line $\overline{\text{ASE}}$ goes low, U3 buffers and places the HP-IB address on the data bus for the processor to read. This only occurs on power up. All of the HP-IB functions are implemented by the HP-IB processor U24. U18 and U23 act as buffers to drive HP-IB cables.

8-B-73. 5508A A2 PROCESSOR BOARD TROUBLESHOOTING

8-B-74. The Processor Board troubleshooting consists of signature analysis tests that require the HP 5005A Signature Multimeter. For all tests, connect the signature analyzer as follows:

CLOCK LEAD: To CLOCK test point on Processor Board

START LEAD: To START test point on Processor Board

STOP LEAD: To STOP test point on Processor Board

8-B-75. Before testing the signatures, check the 5 Volt test signature to ensure that the desired program is running. Where appropriate, signal paths leading to a node that gives an incorrect signature should be traced back until a correct signature is found. The faulty node should then be apparent and if the bad component is not obvious, current tracing or other techniques will be required. The integrity of traces attached to a bad node should always be verfied before any components are replaced. Whenever a correct signature is the last one given along a signal path, verify that all traces leading from that node are also OK.

8-B-76. Processor Board TEST SWITCH

8-B-77. TEST SWITCH A2S3 selects test programs stored in ROM. After entering the correct number into A2S3, the MASTER RESET switch must be toggled. The MPU reads A2S3 after the master reset and runs the corresponding test program. The individual test procedures in this manual show the A2S3 positions as well as any other required switch or jumper positions.

8-B-78. Troubleshooting Procedures

a. Perform Test 1 in Paragraph 8-B-79.

b. Perform Test 2 in Paragraph 8-B-83. If OK go to h, else replace with U5.

NOTE: Steps c through g have been deleted.

h. Move A3 JMP 2 to TEST. Perform Test 3 in Paragraph 8-B-85. If bad, trace to back faulty node, else i. Move A3 JMP 2 back to NORM.

i. Perform Test 4 in paragraph 8-B-87. If OK go to k, else j.

j. Remove A2 JMP 2. Perform Test 10 in Paragraph 8-B-93. If bad, replace U13, else replace U1 or U2, depending on which data line is bad.

k. Perform Test 5 in Paragraph 8-B-88. Are U4 pins 2 - 9 OK? If so n.

l. Remove Keyboard. Perform Test 5 in paragraph 8-B-88. Are U4 pins 2 through 9 OK? If so there is a key board data bus fault. Go to Data Bus Fault Location. Else m.

m. Remove Counter board. Perform Test 5 in Paragraph 8-B-88. Are U4 pins 2 through 9 OK? If so there is a Counter board Data Bus problem. Else replace U4.

n. Perform Test 5 in Paragraph 8-B-88. Are U4 pins 11 - 18 OK? If not replace U4, else o.

o. Perform Test 5 in Paragraph 8-B-88 while pressing the keyboard keys. Are U4 pins 11 through 18 OK? If so q, if not p.

p. Perform Test 5 in Paragraph 8-B-88 while pressing the keyboard keys. Are U4 pins 2 through 9 OK? If so, replace U4. Else go to the keyboard procedures.

q. Perform Test 6 in Paragraph 8-B-89 if the interrupt circuitry is suspect. If Test 6 fails replace U12. Else Processor board checks out OK.

Table 8-B-2. Summary of 5508A Processor Board A2 Signature Analysis Tests

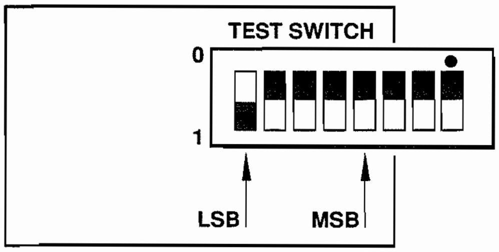
Test #	Test Switch A2S3 Switch Position	Circuitry Under Test
1	00000001	Kernel: U13, U14, U9
2	00000010	All ROMS: U5 - U9
3	00000011	Decode: U11*, U13, U14, U16*, U17*, U19, U20, U21
4	00000100	All RAM: U1, U2, U13
5	00001101	Data Bus Buffer: U4
6	00000001	Interrupt Encoder: U12
10	00000100	MPU Internal RAM: U13

**Not all of this IC is tested*

8-B-79. Test 1. Kernel Test

8-B-80. This test uses the smallest part of the Processor Board circuitry necessary to verify operation of the MPU.

a. On Processor board A2, set switches and jumpers as follows



JMP2: INSTALLED

b. Toggle MASTER RESET switch and measure signatures at the following nodes:

1. +5 V Test Signature: UP73

2. Kernel Signatures:

U13 Pin No.		**U14 Pin No.**		**U15 Pin No.**		**U17 Pin No.**	
22:	UP72	2:	ACH3	1:	UP73	2:	0000
23:	UP72	5:	9COH	2:	UP73	4:	0001
24:	UP72	6:	86CP	3:	0000	6:	UP72
25:	UP72	9:	7U3P			10:	0001
26:	UP72	12:	UP72				
27:	024H	15:	U24H				
28:	024H	16:	UP72				
29:	UP72	19:	UP72				
30:	A18H						
31:	20F3						
32:	07U4						
33:	02H8						
34:	A98H						
35:	0741						
36:	A64C (A64A if in TEST						
37:	02FC						

8-B-91. If any of the kernel signatures are incorrect and the fault cannot be isolated, remove the data bus jumper A2JMP2 and check the above signatures again. If the signatures are now correct, check data bus traces for shorts or opens using a current tracer and logic pulser. Also check ROM and RAM enable lines for shorts.

8-B-92. If the fault causing incorrect signatures can not be isolated, then the MPU or one of its inputs may be at fault. Check the following MPU inputs:

a. Verify +5 V and Ground

b. U13 pins 2 and 3 should be 4 MHz sine waves

c. U13 pins 4, 6, 9 = +5 V

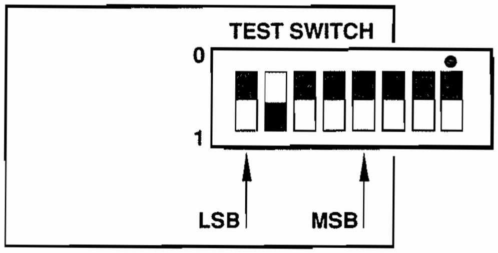
d. U13 pin 8 = 0 V

e. Check for a 1 mHz square wave at U13 pin 40.

8-B-83. Test 2. All ROMS Test

8-B-84. This test verifies operation of U5, assuming that the kernel is functioning properly. All ROM locations are read and data bus signatures are checked to confirm ROM contents.

a. On Processor Board A2, set switches and jumpers as follows:



JMP2: INSTALLED

b. Toggle MASTER RESET switch and measure signatures at the following nodes:

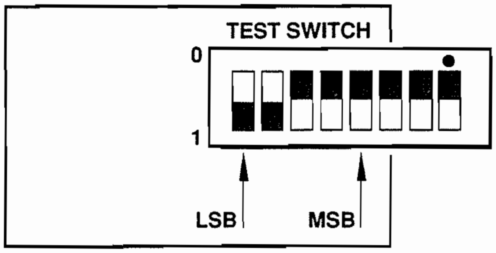
+5 V Test Signature = 3F94

U13 Pin No.	U14 Pin No.	U17 Pin No.	U11 Pin No.
22: 3F9H	2: FCF7	3: 4061	8: 0009
23: 3F9H	5: 24C9	4: 7FU5	
24: 4061	6: 3FA7	5: 7FU5	
25: 8FFP	9: CUUF	6: 4061	
26: 2975	12: F7P6	10: 0009	
27: U7C5	15: 2426	11: 3F9H	
28: 6771	16: 476F	12: 3F94	
29: 5976	19: 055F	13: 0000	
30: 887F			
31: 705H			
32: C60P			
33: 3PCF			
34: CA5H			
35: 3A07			
36: F088			
37: F40U			

8-B-85 Test 3. Decode Test

8-B-86. During this test, the MPU enables all locations in memory to verify proper operation of all address decoder circuits. Tracing signatures back from known bad nodes should be sufficient for fault isolation.

a. On Processor Board A2, set switches and jumpers as follows:



JMP2: INSTALLED

b. On A3, set JMP2 to TEST.

c. Toggle MASTER RESET switch and measure signatures at the following nodes:

+5 V Test Signature: 399F

U19 Pin No.	U21 Pin No.	U24 Pin No.	U20 Pin No.
9: HF2F	10: 9A28	4: HO58	12: 63C1
13: 47F7	11: 6500		6: H72A
14: U986	14: U152		8: PC15
15: 87H2	15: C591		

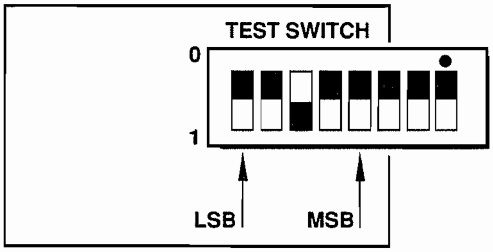
U16 Pin No.	U17 Pin No.	U11 Pin No.
8: 3F3U	8: U16U	8: P268
6: 2H94	10: 790U	
	6: 9F46	
	4: A5HA	

U14 Pin No.	U13 Pin No.
2: 74A9	22: 3995
5: P65P	23: 4093
6: 62FH	24: 9F46
9: 7875	25: A8F6
12: 0377	26: FCUF
15: 312A	27: P82C
16: 0UPA	28: UF80
19: F8U3	29: 9F07
	38: 2H94
	40: 399F

8-B-87. Test 4. All RAM Test

8-B-87a. The Processor Board has 1152 bytes of RAM. The MPU has 128 bytes of internal RAM, RAMS U1 and U2 contain a totall of 1024 bytes. During this test, the MPU writes to and reads from RAM locations. Test 10 exerceses the MPU internal RAM only and should be used for isolation if this test reveals any incorrect signatures. After using test 10 to verify proper internal RAM operation, fault isolation between U1 and U2 is possible because data lines D0 - D3 go to U1 and D4 - D7 go to U2.

a. On Processor Board A2, set switches and jumpers as follows:



JMP 2: INSTALLED

b. Toggle MASTER RESET switch and measure signatures at the following nodes:

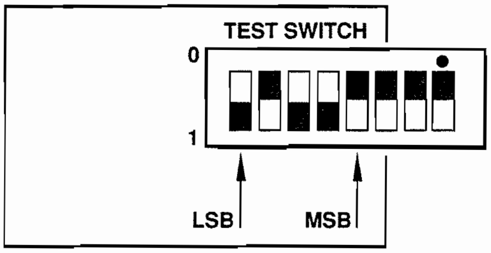
+5 V Test Signature = 4963

U13 Pin No.
30: 1H86
31: C0UC
32: 78U1
33: 6810
34: A8U1
35: 4529
36: H36H
37: A9U4

8-B-88 Test 5. Data Buffer

8-B-88a. This test verifies the operation of U4 and can also be used to check the data bus on A1 and A3. If off the board bus verification is required, the signatures in parentheses shown below should be observed with the indicated key held closed.

a. On Processor Board A2, set switches and jumpers as follows:



JMP2: INSTALLED

b. Toggle MASTER RESET switch and measure signatures at the following nodes:

+5 V Test Signature = FU21

U4 INPUTS

U4 Pin No.

11: H2F7 (U0UF with PRESET key)
12: P3P0 (F1HC with RESOL key)
13: 4U4A (ACC0 with DISTANCE key)
14: 3887 (HF7H with VELOCITY key)
15: 60H3 (8429 with ANGLE key)
16: HCCF (3U46 with LONG key)
17: 6H35 (89FU with SHORT key)
18: U767 (H55F with RESET key)

U4 OUTPUTS

U4 Pin No.

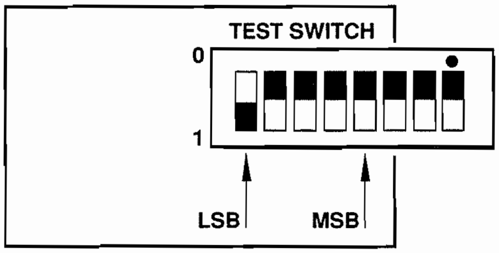
9: 9PC6 (CF8H with PRESET key)
8: HH19 (UU22 with RESOL key)
7: 223F (F6F6 with DISTANCE key)
6: 26U5 (F20U with VELOCITY key)
5: 4AOC (APU1 with ANGLE key)
4: 1OU5 (U4OU with LONG key)
3: P178 (0582 with SHORT key)
2: 0918 (2C23 with RESET key)

8-B-89. Test 6. Interrupt Encoder Test

8-B-90. The Processor Board receives interrupts from the following circuits; English/Metric switch, HP-IB circuits, A1 board, A3 board, and External Reset. A2U12 encodes these interrupts and sends a 3-bit code to the MPU. The MPU uses the 3-bit code to determine which interrupt caused $\overline{IRQ}$ to go low. Use Test 6 only when the MPU does not respond properly to the interrupts.

a. Disconnect Cable W1 from A1 and A3.

b. On Processor Board A2, set switches and jumpers as follows:



JMP2: Don't Care

c. Verify the following:

U12 pins 1, 2, 3, 4, 10, 11, 12, and 13 are high

U12 pin 5 low

U12 pins 6, 7, and 9 are tri-state (Logic Probe dimly lit)

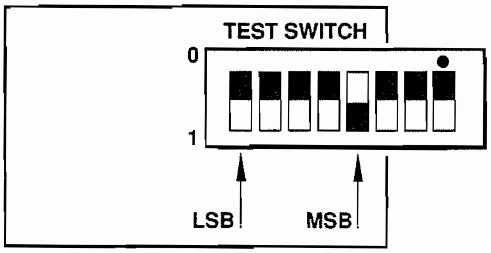
d. Connect an IC test clip to U12. Using a test lead with one end connected to a ground test point, ground the pins indicated in the truth table as low and check U12 output pins 6, 7, 9 and U13 pin 5. For example, in the first test, ground U12 pin 4 and probe U12 pins 6, 7, 9 and U13 pin 5 for low logic levels. Repeat for each line in the truth table.

NOTE

Toggle MASTER RESET after each line of the truth table is verified.

Inputs U12 Pins								**Outputs U12 Pins**			**U13**
10	11	12	13	1	2	3	4	6	7	9	Pin 5
H	H	H	H	H	H	H	L	L	L	L	L
H	H	H	H	H	H	L	H	L	L	H	L
H	H	H	H	H	L	H	H	L	H	L	L
H	H	H	H	L	H	H	H	L	H	H	L
H	H	H	L	H	H	H	H	H	L	L	L
H	H	L	H	H	H	H	H	H	L	H	L
H	L	H	H	H	H	H	H	H	H	L	L
L	H	H	H	H	H	H	H	H	H	H	L

e. Reset TEST SWITCH A2S3 as shown below (Test Mode). Toggle MASTER RESET. Check that the inputs and outputs of U12 and U13 pin 5 are not stuck low.

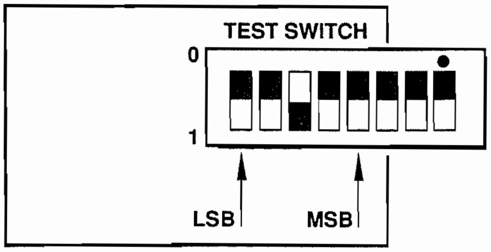


8-B-91. ***HEADING DELETED***

NOTE: Heading 8-B-91 and paragraph 8-B-92 have been deleted. Text continues with heading 8-B-93, below.

8-B-93. Test 10. Internal RAM Test

a. On Processor Board A2, set switches and jumpers as follows:



JMP2: REMOVE

b. Toggle MASTER RESET switch and measure signatures at the following nodes:

+5 V Test Signature: 4963

U13 Pin No.

30: 1H86
31: C0VC
32: 78U1
33: 6810
34: A8U1
35: 4529
36: H36H
37: A9U4

8-B-94. HP-IB Troubleshooting

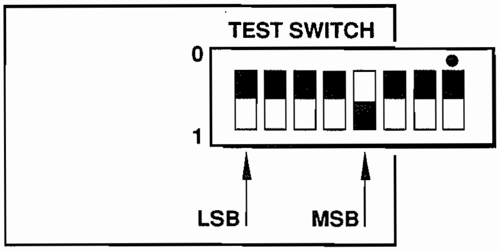
8-B-95. HP-IB processor U24 receives inputs from the MPU and implements all of the HP-IB functions. U24 drives the HP-IB cable by means of buffers U18 and U23. If there is an HP-IB problem, it most likely exists in buffers U18 or U23, if not, check U24.

8-B-96. Start Troubleshooting by using signature analysis to verify that all inputs to U24 are OK. U24 pin 3 ($\overline{CS}$) and pin 4 ($\overline{ASE}$) can be checked using Processor Board Test 3, the decode test.

8-B-97. If U24 is receiving the proper inputs, the next step is to check the operation of buffers U18 and U23. This is accomplished using an oscilloscope or logic probe and an HP 59401 HP-IB Bus Exerciser. Use the Bus Exerciser to freeze action on the HP-IB and then probe points on U18 and U23 to determine if the buffers are working properly. Use a controller such as an HP 85 to initiate bus activity. If these checks are good then U24 must be the problem, since its inputs are OK and buffers U18 and U23 are OK.

8-B-98. HP-IB Verification

a. On Processor Board A2, set TEST SWITCH as shown below:



b. Set HP-IB Address switch to 03 and ADDRESSABLE.

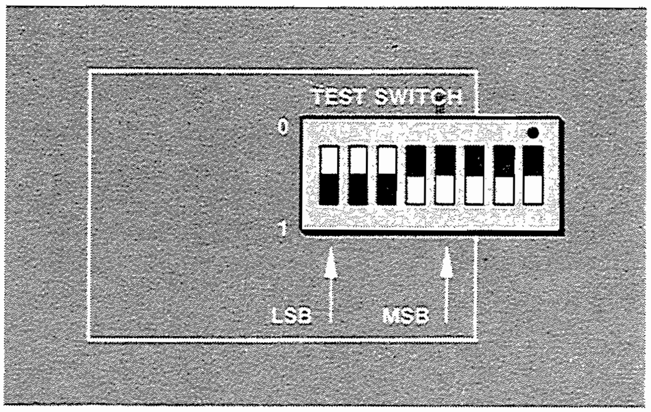
c. Press MASTER RESET switch or set main POWER switch to ON. This places the 5508A in TEST mode.

d. Using an HP-IB Controller, write HP-IB commands to the 5508A and verify that the 5508A responds.

e. Set HP-IB Address switch to "TALK ONLY".

NOTE: Text continues with step "f" at the top of page 8-B-31.

e. For test 9, set TEST SWITCH A2S3 as shown below.



f. Toggle MASTER RESET switch and measure signatures at the following nodes:

+5 V Test Signature: 237C

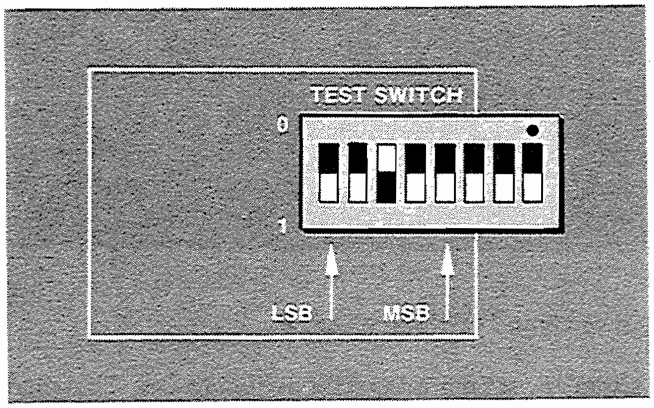
U13 Pin No.

30: PC1P
31: 9UU0
32: H145
33: 2CP5
34: H68F
35: C105
36: H120
37: 2029

If test 9 is OK but test 8 indicates a failure, replace U7. If test 9 gives the first indication of failure, replace U5. If both tests indicate a failure, replace U6. If tests 7, 8, and 9 give correct signatures and test 2 indicates a failure, then replace U8.

8-B-93. Test 10. Internal RAM Test

a. On Processor Board A2, set switches and jumpers as follows:



JMP1: NORM

JMP2: REMOVE

b. Toggle MASTER RESET switch and measure signatures at the following nodes:

+5 V Test Signature: 4963

U13 Pin No.

30: PU68
31: 2A54
32: 8A1U
33: U2CU
34: 796U
35: UFU6
36: 2183
37: 102C

8-B-94. HP-IB Troubleshooting

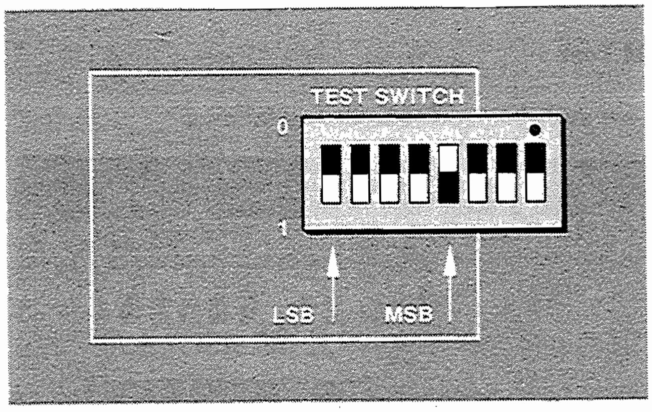
8-B-95. HP-IB processor U24 receives inputs from the MPU and implements all of the HP-IB functions. U24 drives the HP-IB cable by means of buffers U18 and U23. If there is an HP-IB problem, it most likely exists in buffers U18 or U23, if not, check U24.

8-B-96. Start troubleshooting by using signature analysis to verify that all inputs to U24 are O.K. U24 pin 3 ($\overline{CS}$) and pin 4 ($\overline{ASE}$) can be checked using Processor Board Test 3, the decode test.

8-B-97. If U24 is receiving the proper inputs, the next step is to check the operation of buffers U18 and U23. This is accomplished using an oscilloscope or logic probe and an HP 59401 HP-IB Bus Exerciser. Use the Bus Exerciser to freeze action on the HP-IB and then probe points on U18 and U23 to determine if the buffers are working properly. Use a controller such as an HP 85 to initiate bus activity. If these checks are good, then U24 must be the problem, since its inputs are OK and buffers U18 and U23 are OK.

8-B-98. HP-IB Verification

a. On Processor Board A2, set TEST SWITCH as shown below.



b. Set HP-IB Address switch to 03 and ADDRESSABLE.

c. Press MASTER RESET switch or set main POWER switch to ON. This places the 5508A in TEST mode.

d. Using an HP-IB Controller, write HP-IB commands to the 5508A and verify that the 5508A responds.

e. Set HP-IB Address switch to “TALK ONLY”.

f. Press "MASTER RESET" switch.

g. Connect an HP-IB display box or printer as a listener and enter ".5 RECORD" on the 5508A.

h. The HP-IB listener should follow the 5508A display within about 1/2 second. Verify by pressing several keys on the 5508A and check that the external display tracks the display within 1/2 second.

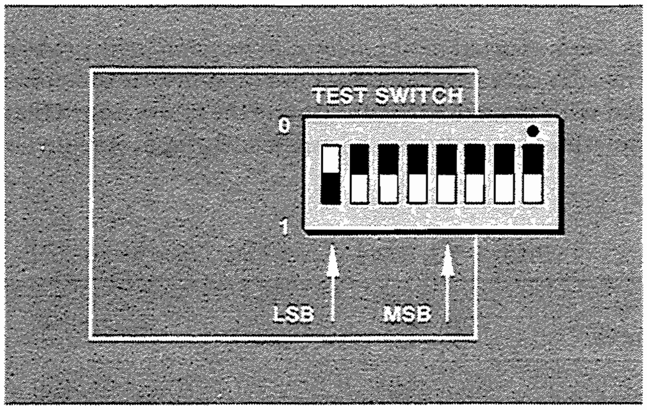
8-B-99. Data Bus Fault Location

8-B-100. Use the following procedures if you suspect a data bus line is shorted to Vcc, ground or another signal trace. Open data line traces, open IC inputs, or open IC outputs can be located by the corresponding signature analysis test. In most cases, signature analysis testing should precede these procedures. Fault location requires that the data bus on Processor board A2 be isolated from the data bus for the rest of the instrument. The 5508A trouble isolation and processor board troubleshooting sections will help determine whether the fault is on the processor board or elsewhere.

8-B-101. The following items of test equipment are recommended for data bus fault location. If necessary, refer to the appropriate test equipment operating manuals.

HP 545A Logic Probe
HP 546A Logic Pulser
HP 547A Current Tracer

8-B-102. Isolate the processor board by setting the TEST SWITCH A2S3 as shown below (kernel test) and toggle MASTER RESET A2S2.



+5 TEST SIGNATURE = UP73

8-B-103. The following Signature Analysis test should run throughout the remainder of the procedures. The kernal test disables the data bus driver A2U4 with a high level on pin 19 (verify +5 at pin 19). When disabled, all A2U4 input/output pins are in the high impedance state. Therefore, all data bus lines on the cable W1 side of A2U4 should be held high by pull-up resistors A2R18. Without A2R18, the bus lines on cable W1 side of A2U4 would float (in the absence of shorts). Check for the high states on all cable W1 data lines.

8-B-104. If any of the data lines on cable W1 are either toggling or stuck low, isloate between A1 and A3 by alternately disconnecting them from cable W1. If disconnecting A1 and A3 does not change the problem, determine the direction of current flow from A2R18 before replacing A2U4. To determine current direction, use a current probe for toggling lines, use a current probe with a logic pulser when a line is stuck low.

8-B-105. After isolating the fault to A1 or A3, use the appropriate procedure below. If the fault is on the processor board go to the processor board troubleshooting section.

8-B-106. Bus Line is Stuck Low

a. Using a logic pulser, apply a 100 Hz pulse train to the suspected data line.

b. Hold the current tracer probe against the logic tracer probe and adjust the current tracer for a dim glow.

c. Using the adjusted current probe, check for current at the IC pins shown in the appropriate trace maps. See Table 8-B-3. Any pin causing a short to ground will be indicated by the glow of the current probe.

d. If none of the pins on the trace maps cause the current probe to glow, locate the short by probing the traces. Starting from the pulser, follow each branch of the trace with the current probe until the probe light goes out. The trace maps show the true positions of the traces on the board. The current probe can detect current in the internal traces of multilayer boards.

8-B-107. Data Line is Toggling

a. Adjust current tracer so that it emits a dim glow when held against the faulty trace near A2R18.

b. Check all IC pins on the correspnding trace map for current flow. Any pin causing the current probe to glow should be removed from the circuit.

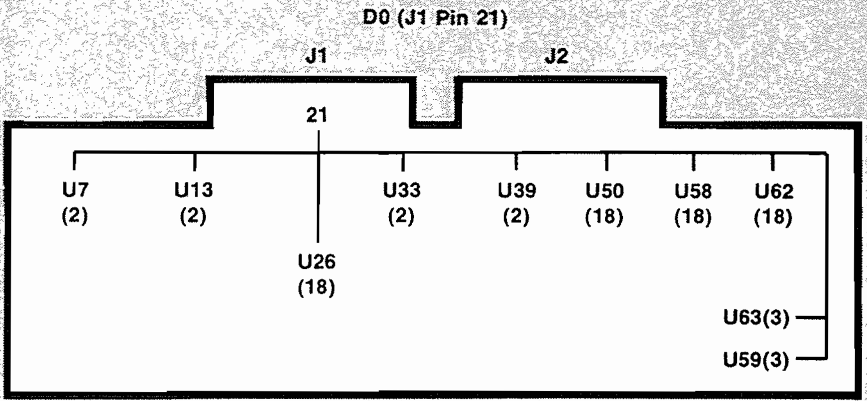
c. If none of the pins on the trace map cause the current probe to glow, locate the short by probing the traces starting from the data line input at Cable W1. Follow each branch of the trace with the current probe until the probe light goes out.

8-B-108. Bus Line Shorted to Vcc

8-B-109. If you suspect a data line is shorted to Vcc, a logic pulser and logic probe can be used to verify the short. The HP 546A logic pulser can usually drive any of these data lines low. If the pulser is unable to drive a data line low, a current tracer can be used with the pulser to first isolate the faulty board then to locate the trace short of IC pin causing the short. After isolating the faulty board, refer to the appropriate data line trace maps (see Table 8-B-3) to locate the short.

Table 8-B-3. 5508A Data Line Trace Maps

5508A Assembly	Data Line	Illustration
A3	D0 and D1	Figure 8-B-6
A3	D2 and D3	Figure 8-B-7
A3	D4 and D5	Figure 8-B-8
A3	D6 and D7	Figure 8-B-9
A1	D0 and D1	Figure 8-B-10
A1	D2 and D3	Figure 8-B-11
A1	D4 and D5	Figure 8-B-12
A1	D6 and D7	Figure 8-B-13
A2	D0 and D1	Figure 8-B-14
A2	D2 and D3	Figure 8-B-15
A2	D4 and D5	Figure 8-B-16
A2	D6 and D7	Figure 8-B-17


D0 (J1 Pin 21)
J1
J2
21
U7 (2)
U13 (2)
U26 (18)
U33 (2)
U39 (2)
U50 (18)
U58 (18)
U62 (18)
U63(3)
U59(3)

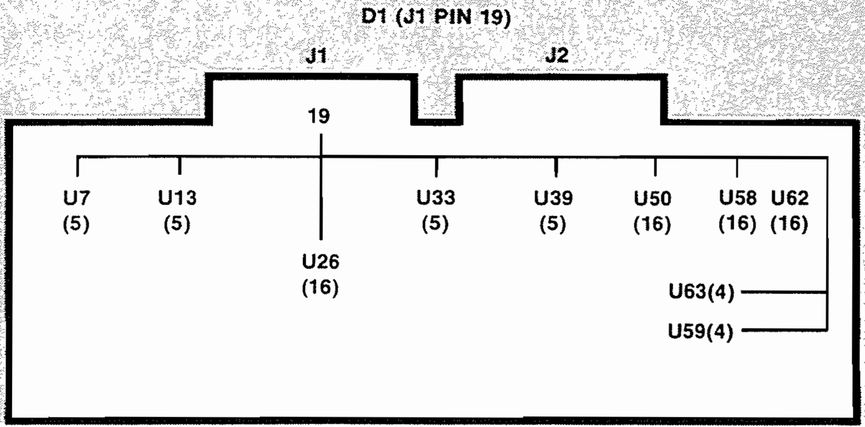
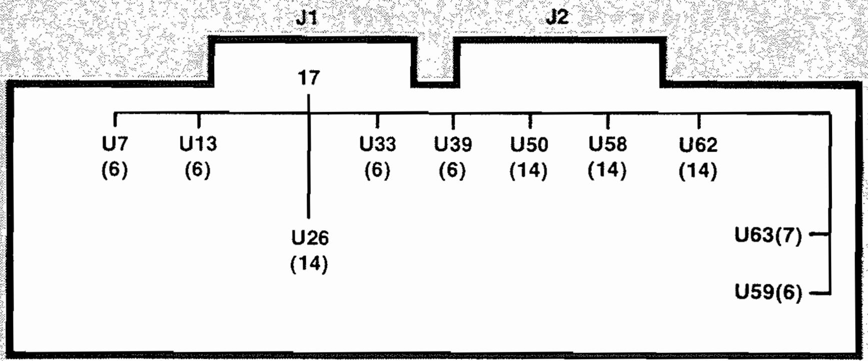

D1 (J1 PIN 19)
J1
J2
19
U7 (5)
U13 (5)
U26 (16)
U33 (5)
U39 (5)
U50 (16)
U58 (16)
U62 (16)
U63(4)
U59(4)

Figure 8-B-6. 5508A A3 Data Line Trace Maps, D0 and D1

D2 (J1 PIN 17)


J1
J2
17
U7
(6)
U13
(6)
U33
(6)
U39
(6)
U50
(14)
U58
(14)
U62
(14)
U26
(14)
U63(7)
U59(6)

D3 (J1 PIN 15)

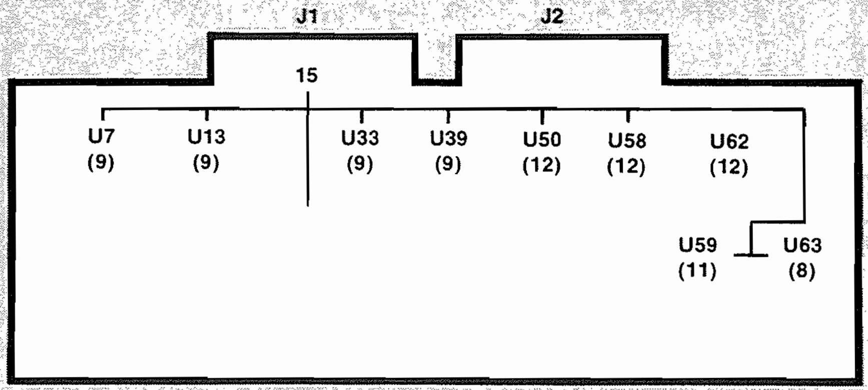

J1
J2
15
U7
(9)
U13
(9)
U33
(9)
U39
(9)
U50
(12)
U58
(12)
U62
(12)
U59
(11)
U63
(8)

Figure 8-B-7. 5508A A3 Data Line Trace Maps, D2 and D3

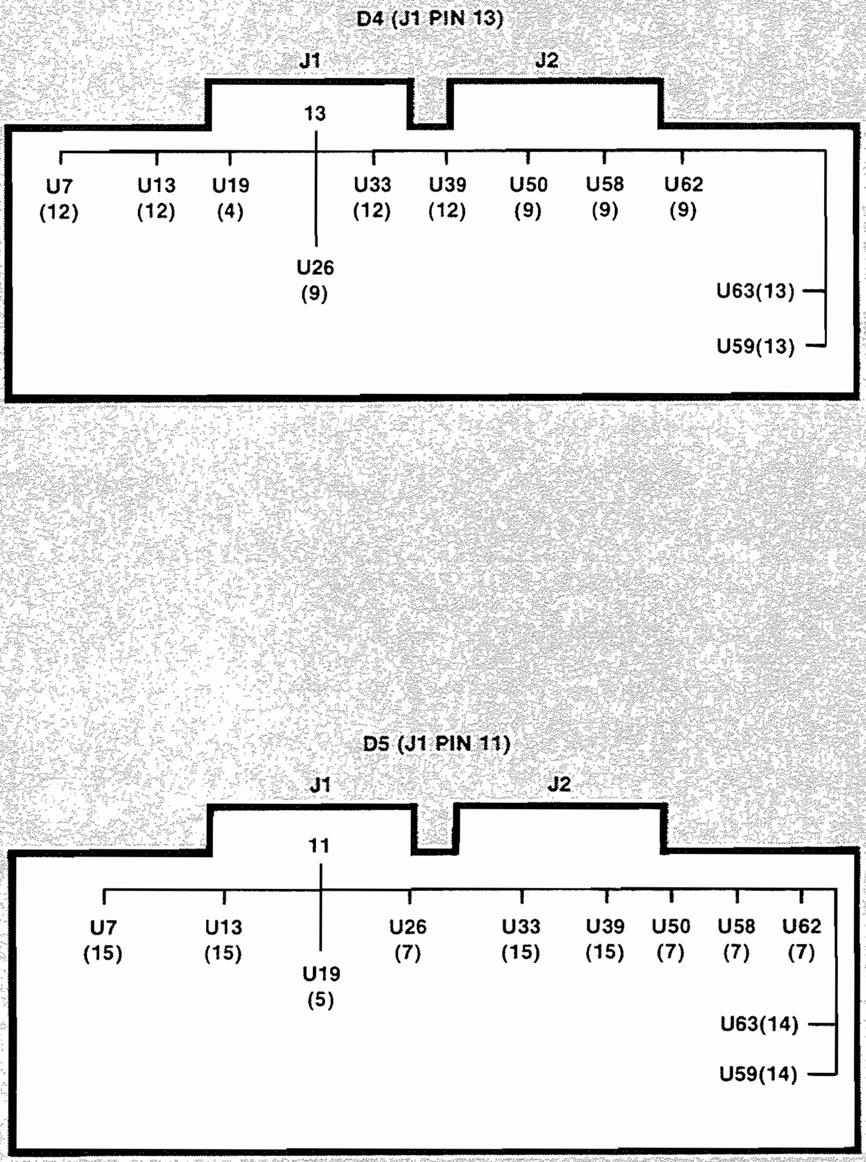
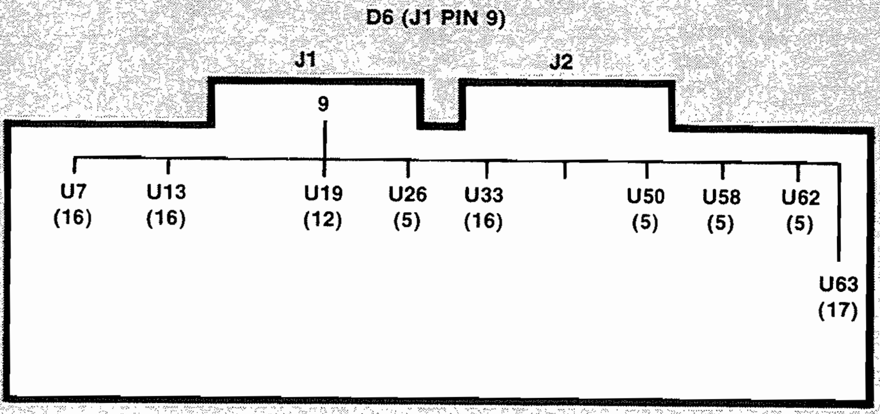

D4 (J1 PIN 13)
J1
J2
13
U7 (12)
U13 (12)
U19 (4)
U33 (12)
U39 (12)
U50 (9)
U58 (9)
U62 (9)
U26 (9)
U63(13)
U59(13)
D5 (J1 PIN 11)
J1
J2
11
U7 (15)
U13 (15)
U26 (7)
U33 (15)
U39 (15)
U50 (7)
U58 (7)
U62 (7)
U19 (5)
U63(14)
U59(14)

Figure 8-B-8. 5508A A3 Data Line Trace Maps, D4 and D5


D6 (J1 PIN 9)
J1
J2
9
U7 (16)
U13 (16)
U19 (12)
U26 (5)
U33 (16)
U50 (5)
U58 (5)
U62 (5)
U63 (17)

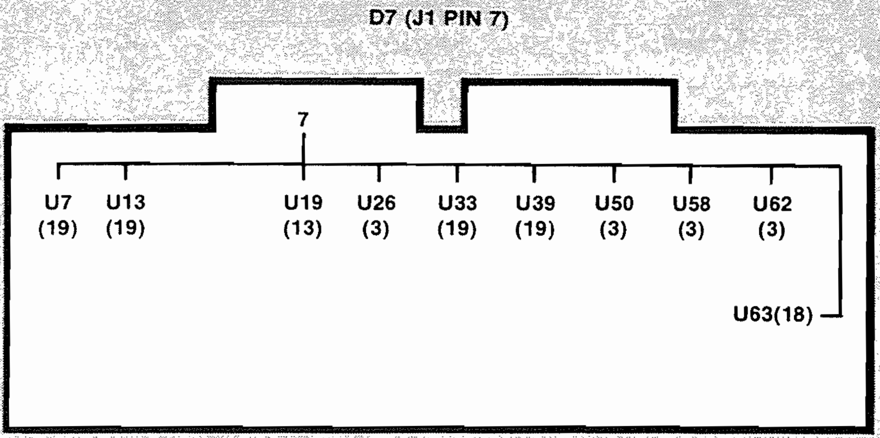

D7 (J1 PIN 7)
7
U7 (19)
U13 (19)
U19 (13)
U26 (3)
U33 (19)
U39 (19)
U50 (3)
U58 (3)
U62 (3)
U63(18)

Figure 8-B-9. 5508A A3 Data Line Trace Maps, D6 and D7

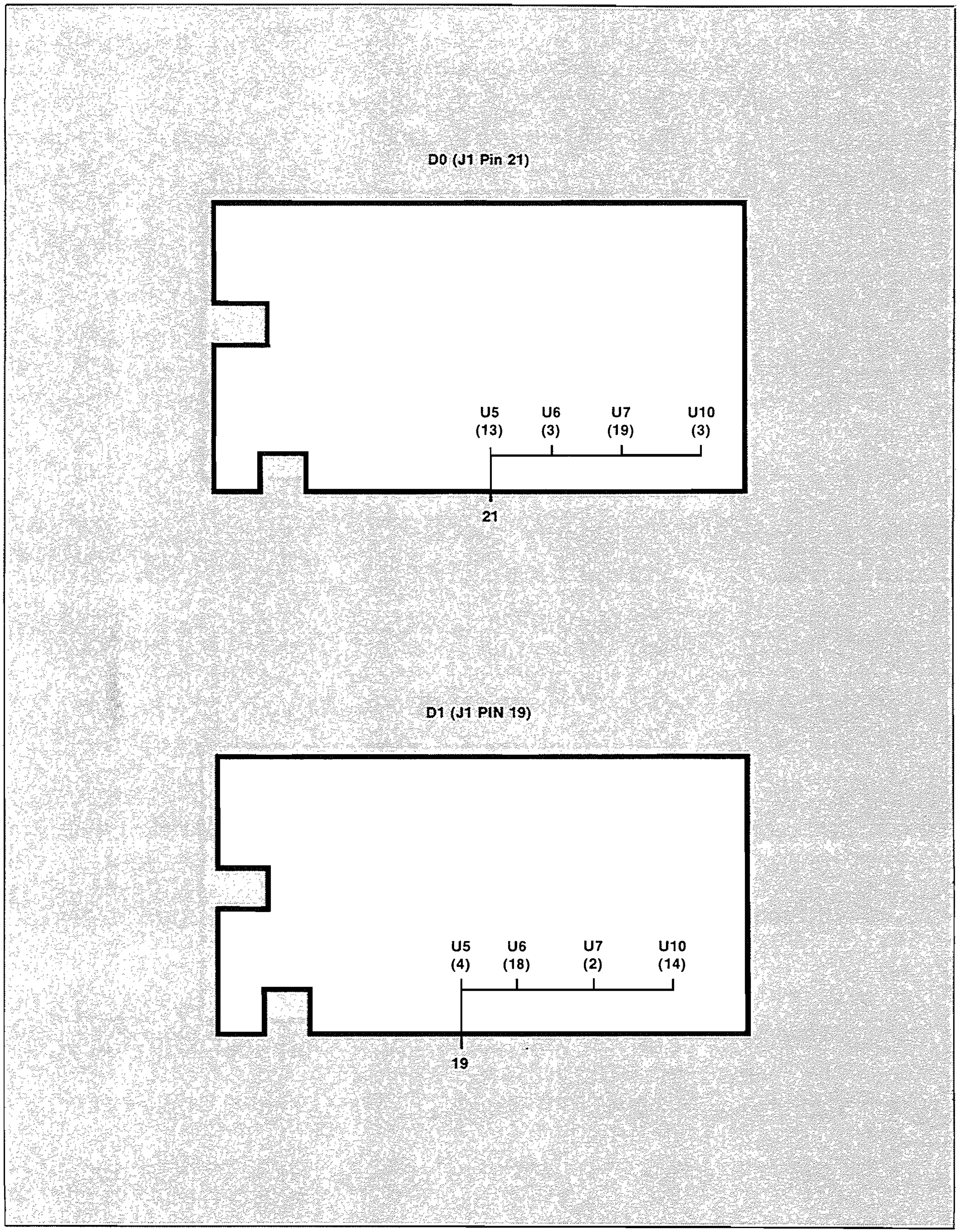

D0 (J1 Pin 21)
U5
(13)
U6
(3)
U7
(19)
U10
(3)
21
D1 (J1 PIN 19)
U5
(4)
U6
(18)
U7
(2)
U10
(14)
19

Figure 8-B-10. 5508A A1 Data Line Trace Maps, D0 and D1

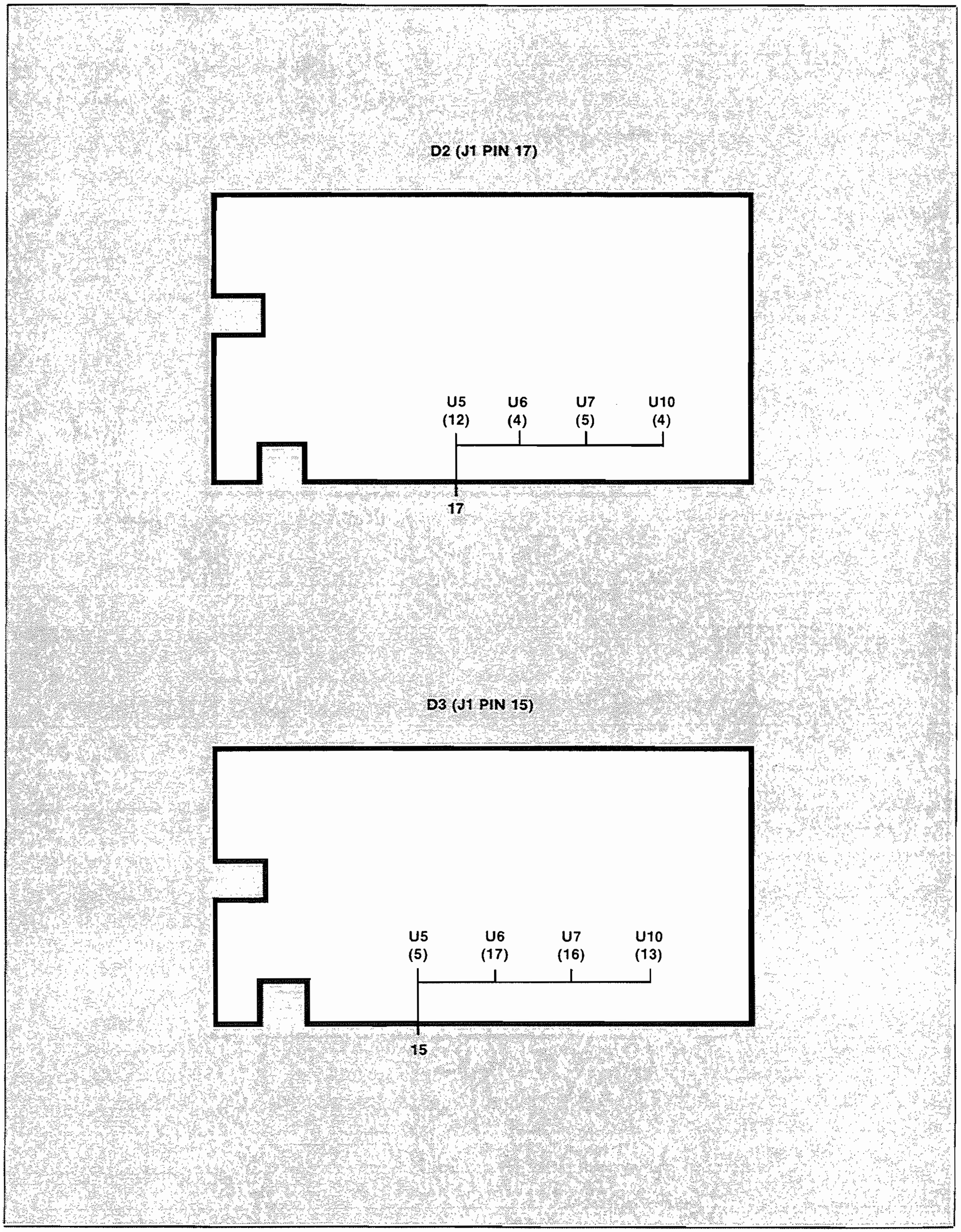
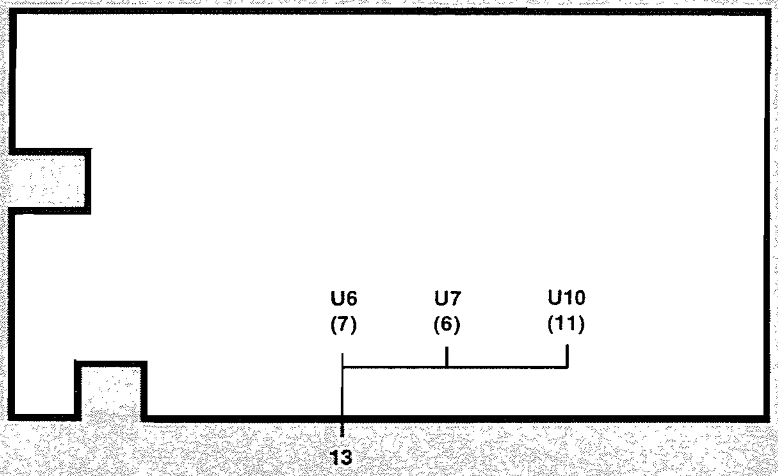

D2 (J1 PIN 17)
U5 (12)
U6 (4)
U7 (5)
U10 (4)
17
D3 (J1 PIN 15)
U5 (5)
U6 (17)
U7 (16)
U10 (13)
15

Figure 8-B-11. 5508A A1 Data Line Trace Maps, D2 and D3

D4 (J1 PIN 13)


U6
(7)
U7
(6)
U10
(11)
13

D5 (J1 PIN 11)

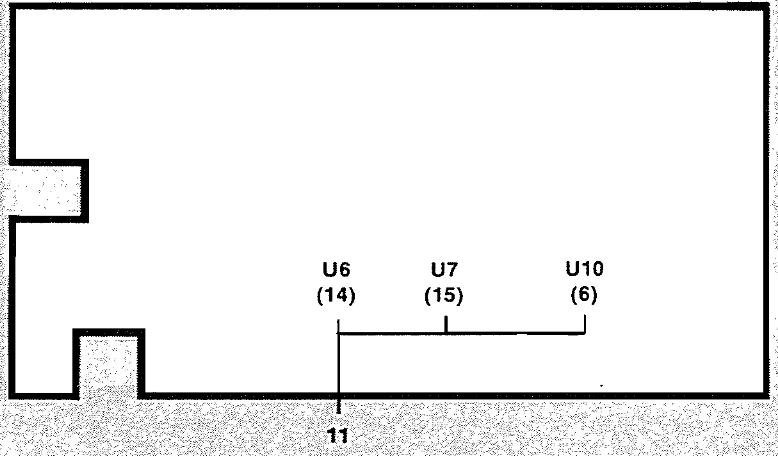

U6
(14)
U7
(15)
U10
(6)
11

Figure 8-B-12. 5508A A1 Data Line Trace Maps, D4 and D5

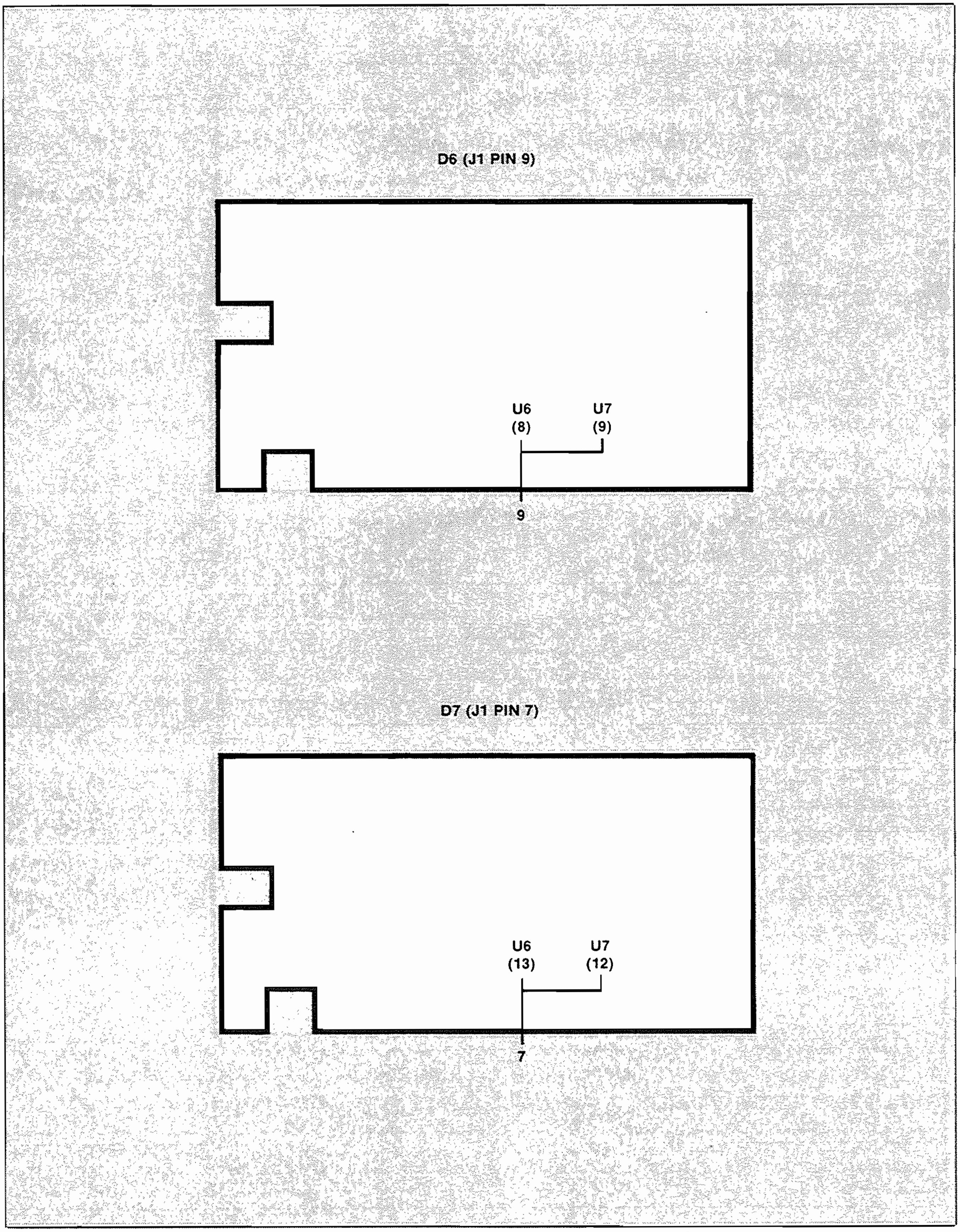

D6 (J1 PIN 9)
U6
(8)
U7
(9)
9
D7 (J1 PIN 7)
U6
(13)
U7
(12)
7

Figure 8-B-13. 5508A A1 Data Line Trace Maps, D6 and D7

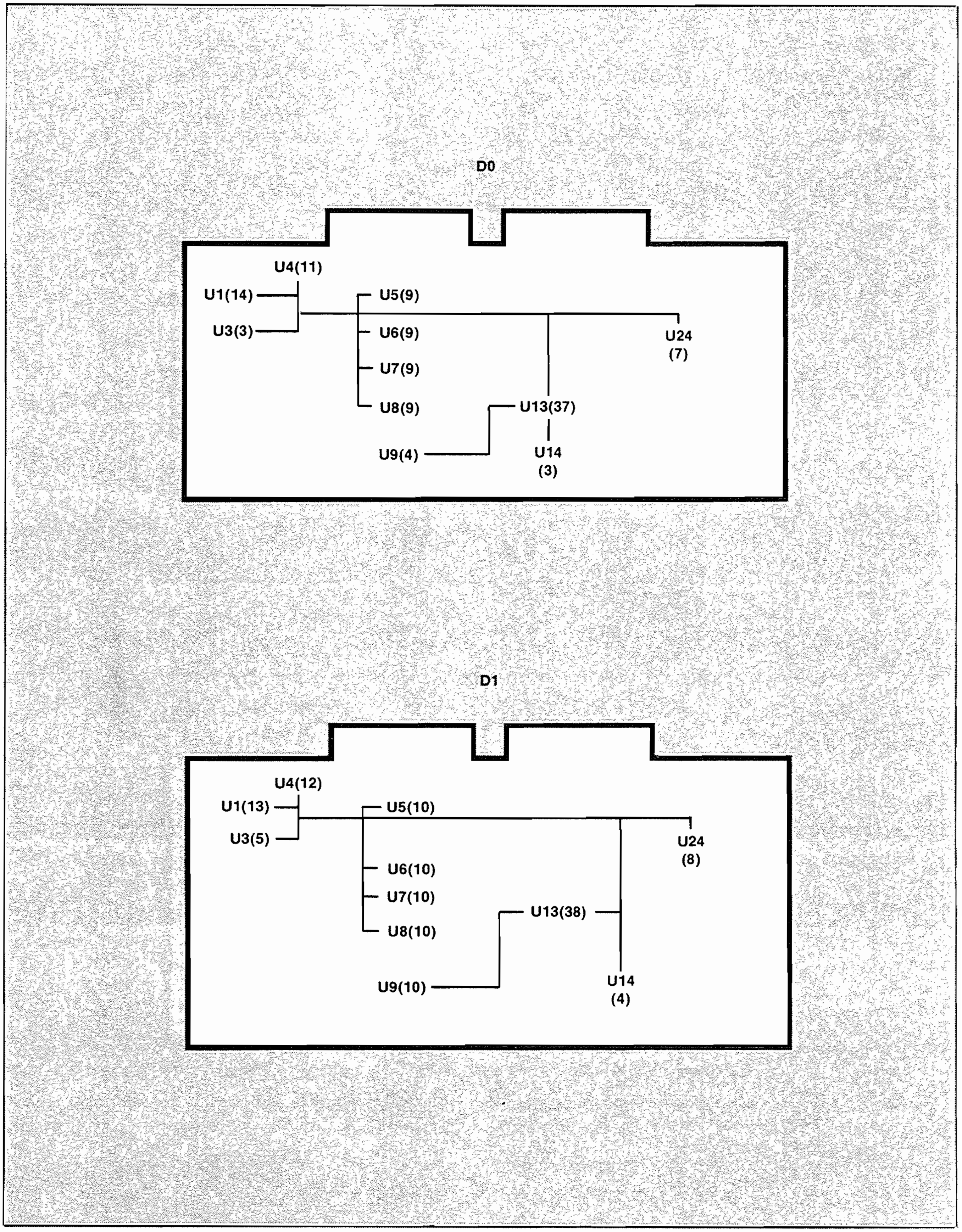

D0
U4(11)
U1(14)
U3(3)
U5(9)
U6(9)
U7(9)
U8(9)
U24
(7)
U13(37)
U9(4)
U14
(3)
D1
U4(12)
U1(13)
U3(5)
U5(10)
U24
(8)
U6(10)
U7(10)
U13(38)
U8(10)
U9(10)
U14
(4)

Figure 8-B-14. 5508A A2 Data Line Trace Maps, D0 and D1

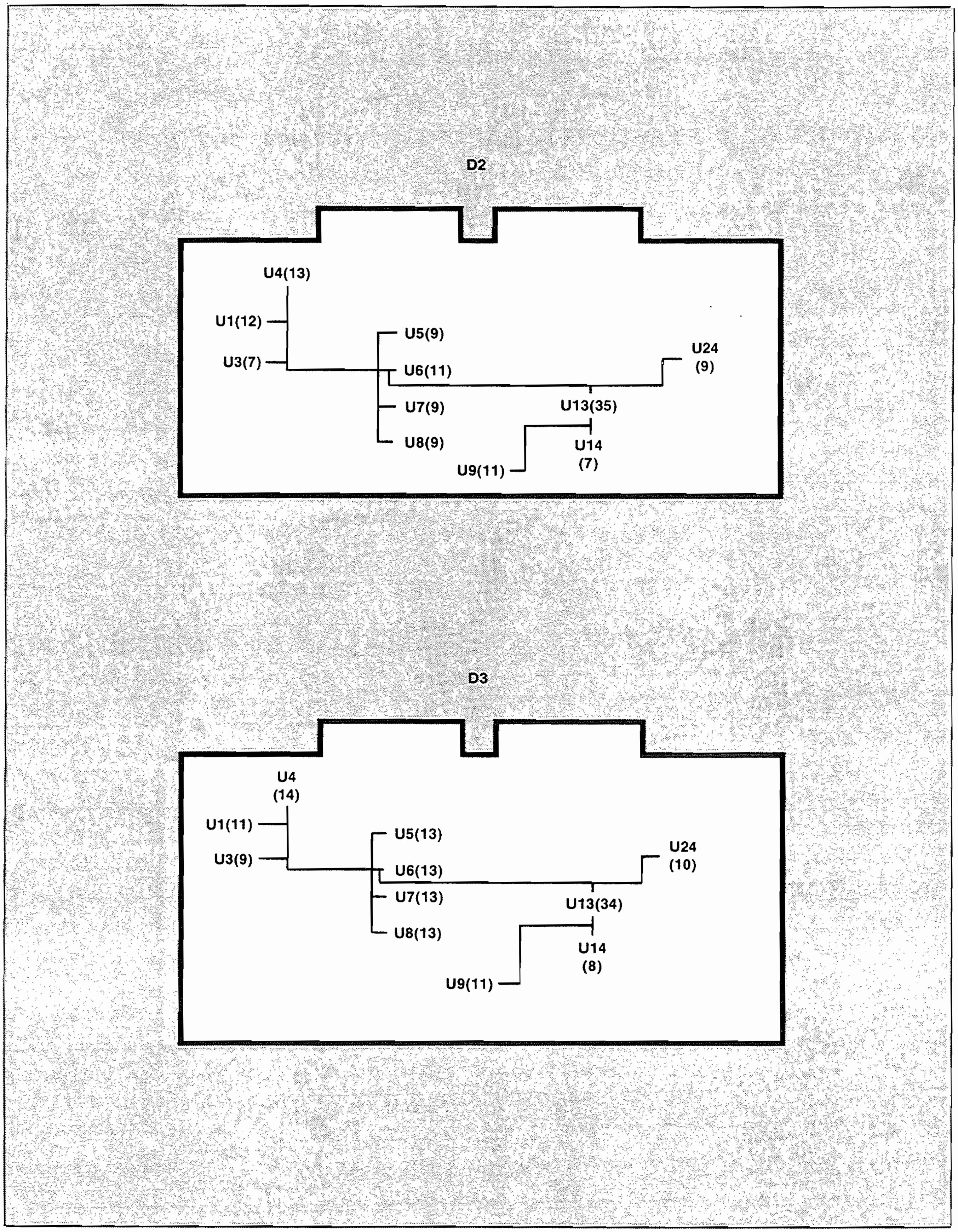
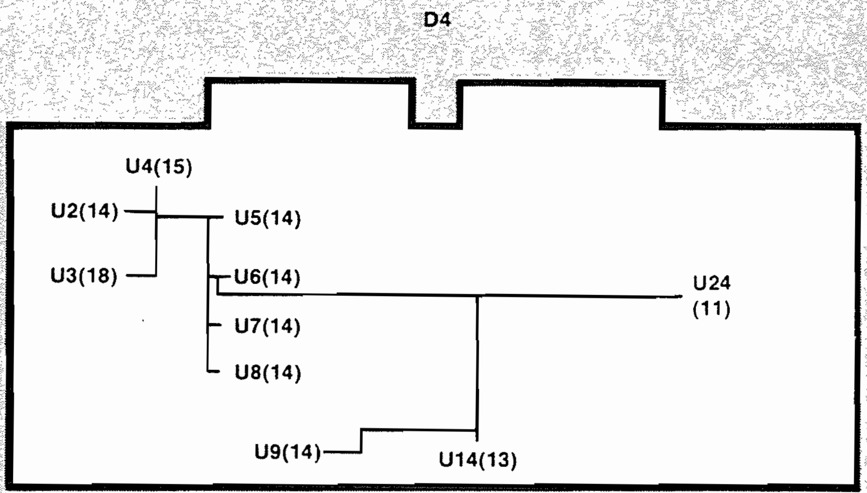

D2
U4(13)
U1(12)
U3(7)
U5(9)
U6(11)
U7(9)
U8(9)
U24
(9)
U13(35)
U14
(7)
U9(11)
D3
U4
(14)
U1(11)
U3(9)
U5(13)
U6(13)
U7(13)
U8(13)
U24
(10)
U13(34)
U14
(8)
U9(11)

Figure 8-B-15. 5508A A2 Data Line Trace Maps, D2 and D3


D4
U4(15)
U2(14)
U5(14)
U3(18)
U6(14)
U24
(11)
U7(14)
U8(14)
U9(14)
U14(13)

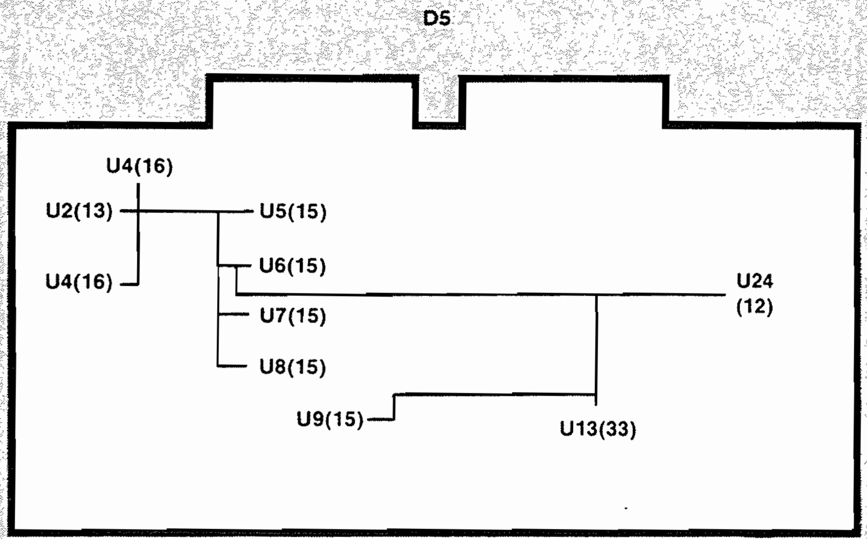

D5
U4(16)
U2(13)
U5(15)
U6(15)
U4(16)
U24
(12)
U7(15)
U8(15)
U9(15)
U13(33)

Figure 8-B-16. 5508A A2 Data Line Trace Maps, D4 and D5

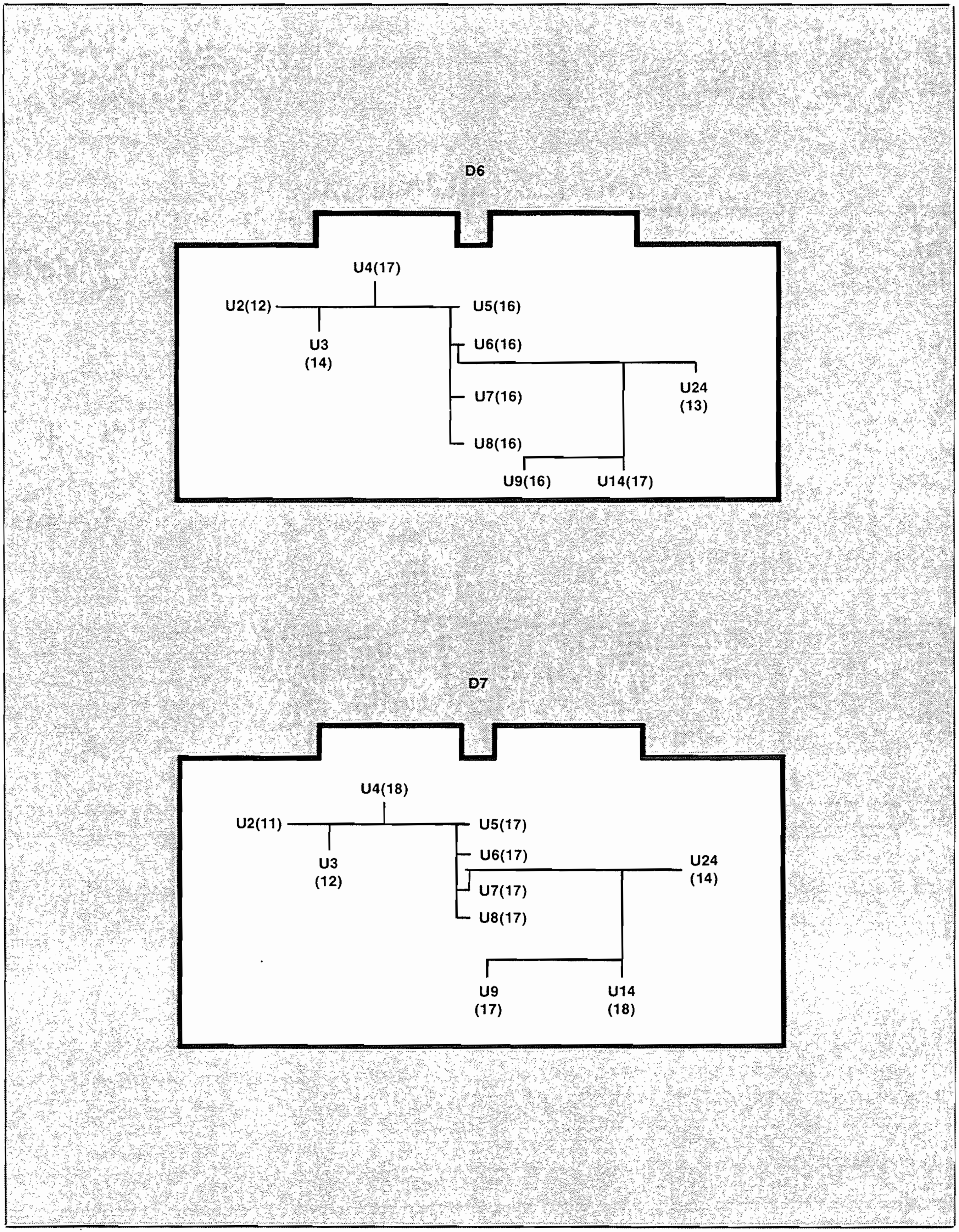
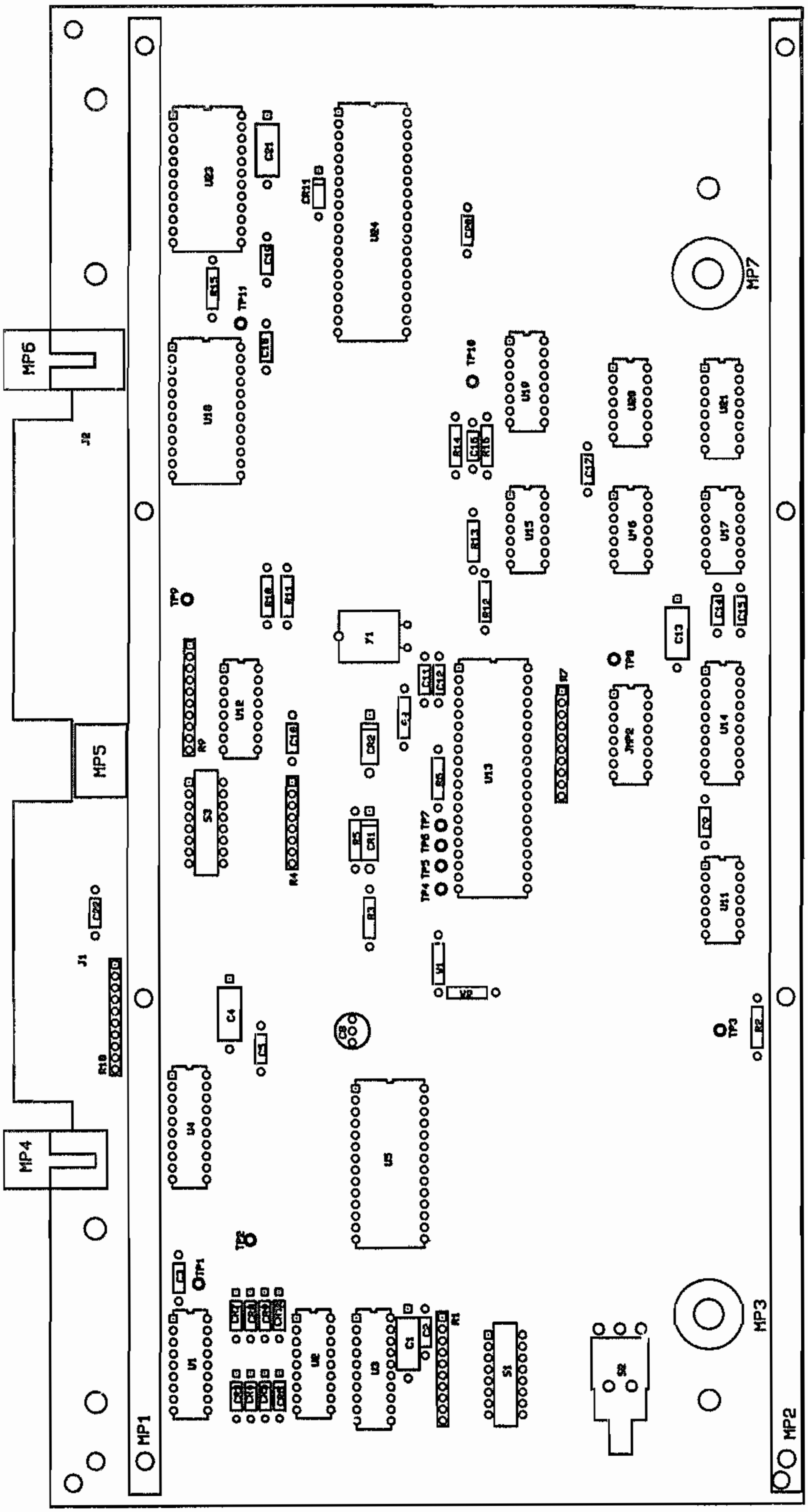

D6
U4(17)
U2(12)
U5(16)
U3
(14)
U6(16)
U24
(13)
U7(16)
U8(16)
U9(16)
U14(17)
D7
U4(18)
U2(11)
U5(17)
U6(17)
U3
(12)
U24
(14)
U7(17)
U8(17)
U9
(17)
U14
(18)

Figure 8-B-17. 5508A A2 Data Line Trace Maps, D6 and D7

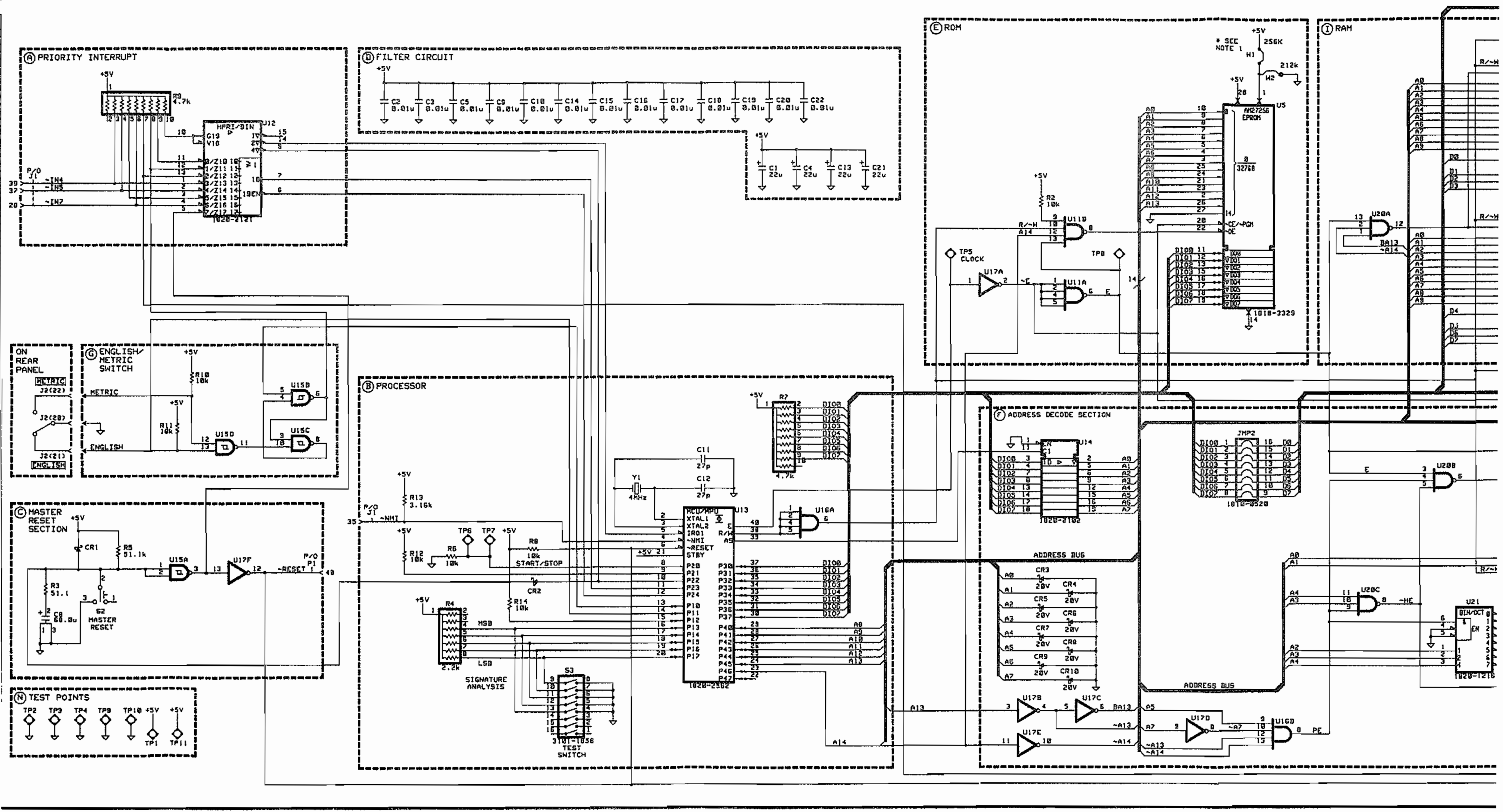

MP1
MP2
MP3
MP4
MP5
MP6
MP7
J1
J2
U1
U3
U4
U5
U6
U11
U12
U13
U14
U15
U16
U17
U18
U19
U20
U21
U23
U24
S1
S2
S3
Y1
R1
R2
R3
R4
R5
R7
R9
R10
R12
R13
R14
R15
R16
C1
C2
C3
C4
C5
C6
C7
C9
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C20
C21
CR1
CR2
CR11
TP1
TP2
TP3
TP4
TP5
TP6
TP7
TP8
TP9
TP10
TP11
JMP2
V1
V2

Part of Figure 8-B-18. 5508A A2 Processor Board
05508-60002, Date Code 90411 & above

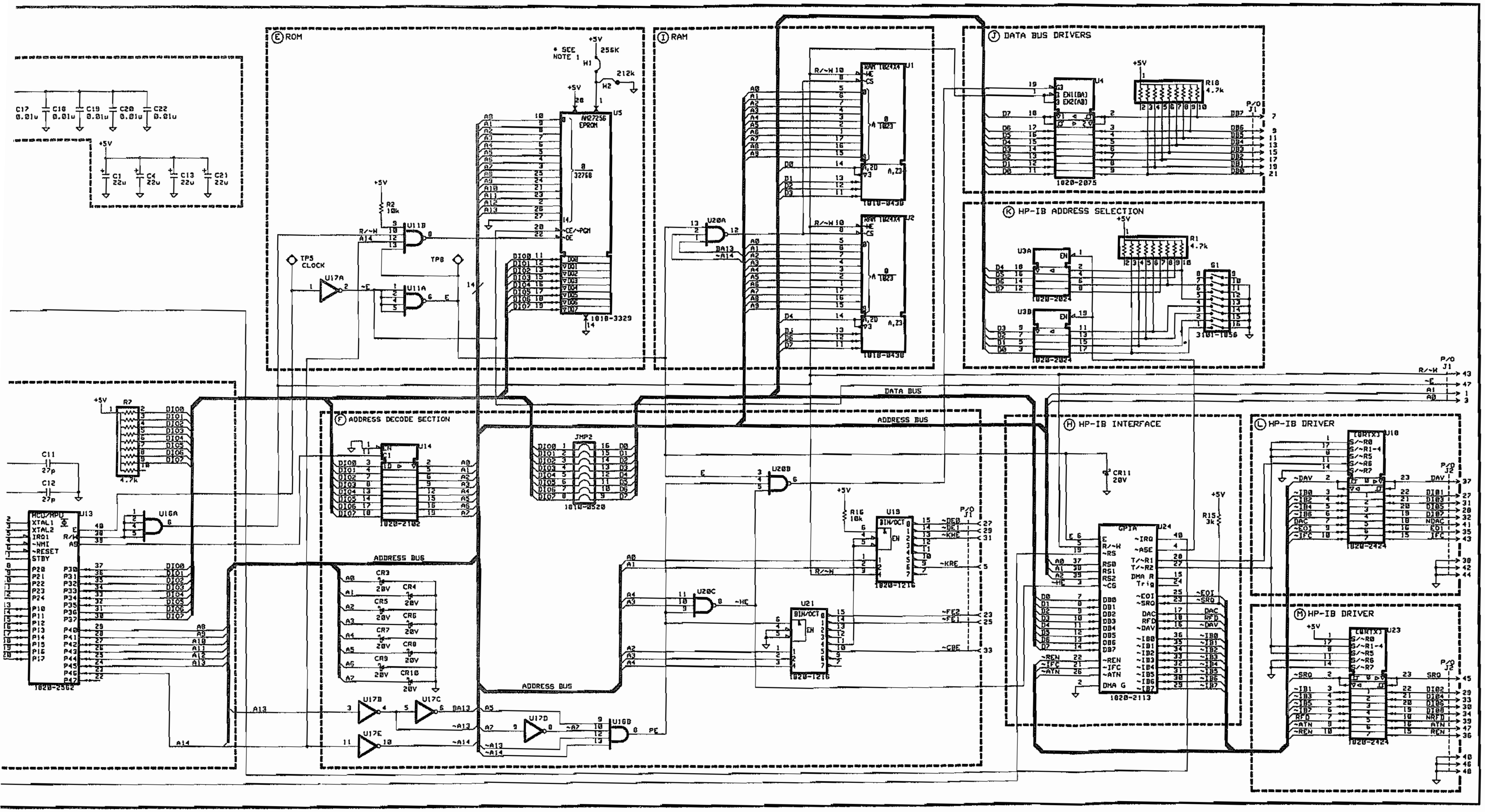
A2 5508A PROCESSOR BOARD (05508-60002) DATE CODE 90411 and ABOVE

J1 PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	A1	TO A3J1-1	Ⓕ
2	+5V	FROM A5J1-2	Ⓓ
3	A0	TO A3J1-2	Ⓕ
4	+5V	FROM A5J1-4	Ⓓ
5	KRE	TO A1J1-5	Ⓕ
6	+5V	FROM A5J1-6	Ⓓ
7	D7	TO/FROM A1J1-7 & A3J1-7	Ⓙ
8	+5V	FROM A5J1-8	Ⓓ
9	D6	TO/FROM A1J1-9 & A3J1-9	Ⓙ
10	+5V	FROM A5J1-10	Ⓓ
11	D5	TO/FROM A1J1-11 & A3J1-11	Ⓙ
12	+5V	FROM A5J1-12	Ⓓ
13	D4	TO/FROM A1J1-13 & A3J1-13	Ⓙ
14	+5V	FROM A5J1-14	Ⓓ
15	D3	TO/FROM A1J1-15 & A3J1-15	Ⓙ
16	+5V	FROM A5J1-16	Ⓓ
17	D2	TO/FROM A1J1-17 & A3J1-17	Ⓙ
18	+5V	FROM A5J1-18	Ⓓ
19	D1	TO/FROM A1J1-19 & A3J1-19	Ⓙ
20	+5V	FROM A5J1-20	Ⓓ
21	D0	TO/FROM A1J1-21 & A3J1-21	Ⓙ
22	NC	—	—
23	FE2	TO A3J1-23	Ⓕ
24	NC	—	—
25	FE1	TO A3J1-25	Ⓕ
26	+5VREMOTE SENSE	FROM A5J1-26	Ⓓ
27	DE0	TO A1J1-27	Ⓕ
28	INT	FROM A3J1-28	Ⓐ
29	DE1	TO A1J1-29	Ⓕ
30	GND	FROM A5J1-30	Ⓓ
31	KWE	TO A1J1-31	Ⓕ
32	GND	FROM A5J1-32	Ⓓ
33	CBE	TO A3J1-33	Ⓕ
34	GND	FROM A5J1-34	Ⓓ
35	NMI	FROM A3J1-35	Ⓑ
36	GND	FROM A5J1-36	Ⓓ
37	IN5	FROM A1J1-37	Ⓐ
38	GND	FROM A5J1-38	Ⓓ
39	IN4	FROM A3J1-39	Ⓐ
40	GND	FROM A5J1-40	Ⓓ
41	NC	—	—
42	GND	FROM A5J1-42	Ⓓ
43	R/W	TO A3J1-43	Ⓘ
44	GND	FROM A5J1-44	Ⓓ
45	NC	—	—
46	GND	FROM A5J1-46	Ⓓ
47	E	TO A1J1-47 & A3J1-47	Ⓔ
48	GND	FROM A5J1-48	Ⓓ
49	RESET	TO A3J1-49	Ⓒ
50	GND	FROM A5J1-50	Ⓓ

J2 PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	NC		
2	NC		
3	NC		
4	NC		
5	NC		
6	NC		
7	NC		
8	NC		
9	NC		
10	NC		
11	NC		
12	NC		
13	NC		
14	NC		
15	NC		
16	NC		
17	NC		
18	NC		
19	NC		
20	ENG-MET GND	TO A4J1-20	Ⓖ
21	ENGLISH SW	FROM A4J1-21	Ⓖ
22	METRIC SW	FROM A4J1-22	Ⓖ
23	NC		
24	NC		
25	NC		
26	NC		
27	DIO1	TO/FROM J2-1	Ⓛ
28	DIO5	TO/FROM J2-13	Ⓛ
29	DIO2	TO/FROM J2-2	Ⓜ
30	DIO6	TO/FROM J2-14	Ⓜ
31	DIO3	TO/FROM J2-3	Ⓛ
32	DIO7	TO/FROM J2-15	Ⓛ
33	DIO4	TO/FROM J2-4	Ⓜ
34	DIO8	TO/FROM J2-16	Ⓜ
35	EOI	TO/FROM J2-5	Ⓛ
36	REN	TO FROM J2-17	Ⓜ
37	DAV	TO/FROM J2-6	Ⓛ
38	DAV GND	FROM J2-18	Ⓛ Ⓜ
39	NRFD	TO/FROM J2-7	Ⓝ
40	NRFD GND	FROM J2-19	Ⓛ Ⓜ
41	NDAC	TO/FROM J2-8	Ⓛ
42	NDAC GND	FROM J2-20	Ⓛ Ⓜ
43	IFC	TO/FROM J2-9	Ⓛ
44	IFC GND	FROM J2-21	Ⓛ Ⓜ
45	SRQ	TO/FROM J2-10	Ⓜ
46	SRQ GND	FROM J2-22	Ⓛ Ⓜ
47	ATN	TO/FROM J2-11	Ⓜ
48	ATN GND	FROM J2-23	Ⓛ Ⓜ
49	SHIELD	FROM J2-12	Ⓛ Ⓜ
50	SIGNAL GND	FROM J2-24	Ⓛ Ⓜ


Ⓐ PRIORITY INTERRUPT
Ⓓ FILTER CIRCUIT
Ⓔ ROM
Ⓘ RAM
ON REAR PANEL
METRIC
ENGLISH
Ⓖ ENGLISH/METRIC SWITCH
Ⓑ PROCESSOR
Ⓒ MASTER RESET SECTION
MASTER RESET
Ⓝ TEST POINTS
Ⓕ ADDRESS DECODE SECTION
ADDRESS BUS
SIGNATURE ANALYSIS
TEST SWITCH
START/STOP
TP5 CLOCK
* SEE NOTE 1
256K
512K
AM27256 EPROM
32768
1820-2121
1820-2562
1820-2102
1820-3329
1810-0520
3101-1856
1820-1216
U12
U13
U5
U14
U21
JMP2
MCU/MPU
4MHz
~RESET
~NMI
MSB
LSB

NOTE 1
INSTALL ONLY W1 OR W2.
INSTALL W1 FOR 256k ROM.
INSTALL W2 FOR 512k ROM.


Ⓔ ROM
Ⓘ RAM
Ⓙ DATA BUS DRIVERS
Ⓚ HP-IB ADDRESS SELECTION
Ⓕ ADDRESS DECODE SECTION
Ⓗ HP-IB INTERFACE
Ⓛ HP-IB DRIVER
Ⓜ HP-IB DRIVER
DATA BUS
ADDRESS BUS
* SEE NOTE 1
AM27256 EPROM
32768
1818-3329
RAM 1024X4
1818-0438
1820-2075
1820-2024
3101-1856
1820-2102
1818-0520
JMP2
1820-1216
GPIA
1820-2113
1820-2424
MCU/MPU
1820-2562
TP5 CLOCK
TP8
P/O J1
P/O J2
+5V

1. REFERENCE DESIGNATIONS WITH THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN HENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT; AVERAGE VALUES SHOWN.

Reference Designations
C1-22
CR1-11
JMP1
R1-16,18
S1-3
TP1-11
U1-5, U11-21
U23-U24
Y1

TABLE OF ACTIVE ELEMENTS

Reference Desig.	HP Part No.	Mfr. Part No.
U1,2	1818-0438	TMS2114-45NL
U3	1820-2024	SN74LS244N
U4	1820-2075	SN74LS245N
U5	05508-80011	05508-80011
U10, 19, 21	1820-1216	SN74LS138N
U11	1820-0686	SN74S20N
U12	1820-2121	SN74LS348N
U13	1820-2562	1820-2562
U14	1820-2102	SN74LS373N
U15	1820-1425	SN74LS132N
U16	1820-1205	SN74LS21N
U17	1820-0683	SN74S04N
U18, 23	1820-2424	MC3447P
U20	1820-1202	SN74LS10N
U24	1820-2113	MC68488L

Figure 8-B-18. 5508A A2 Processor Board 05508-60002

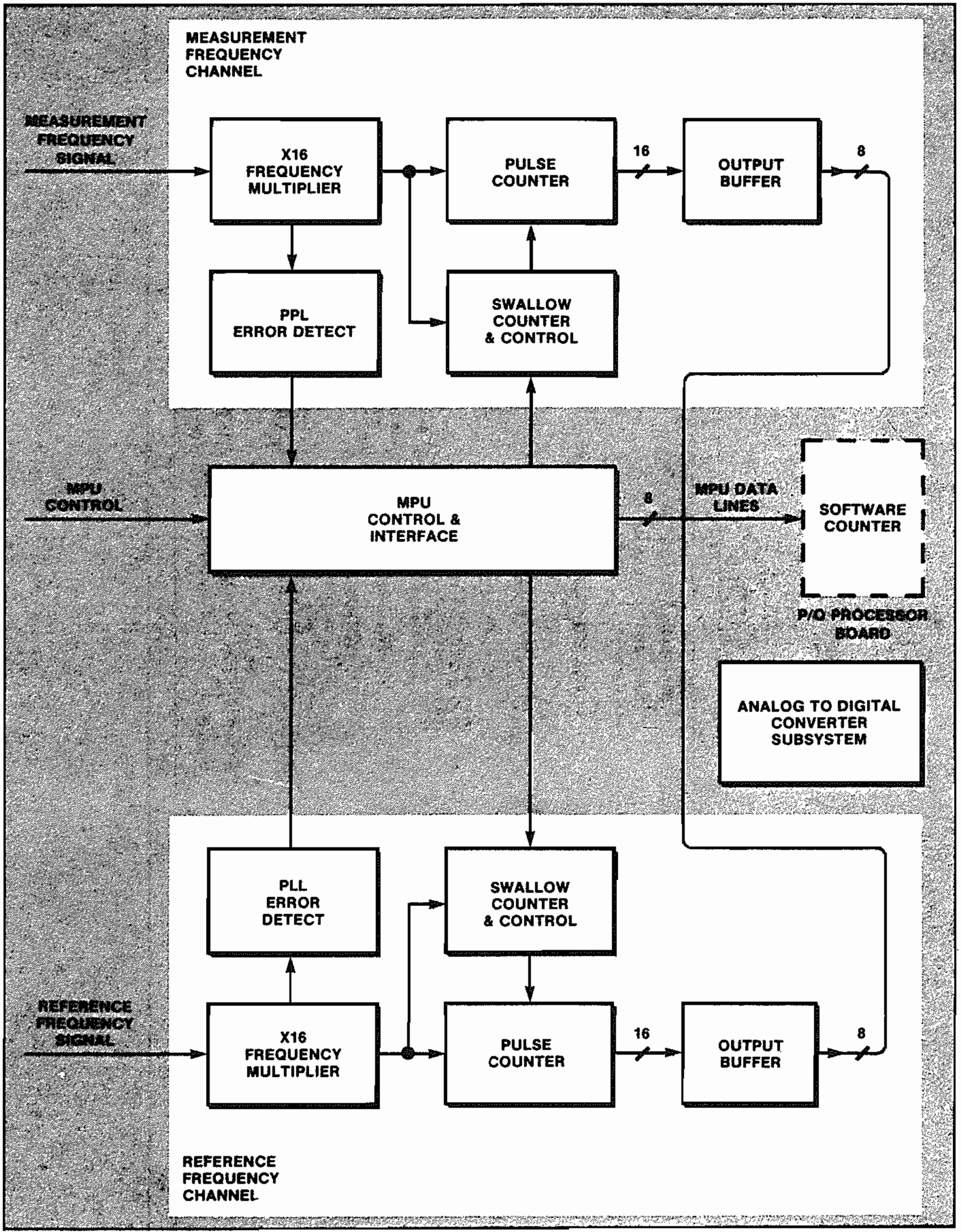

MEASUREMENT FREQUENCY CHANNEL
MEASUREMENT FREQUENCY SIGNAL
X16 FREQUENCY MULTIPLIER
PULSE COUNTER
16
OUTPUT BUFFER
8
PPL ERROR DETECT
SWALLOW COUNTER & CONTROL
MPU CONTROL
MPU CONTROL & INTERFACE
8
MPU DATA LINES
SOFTWARE COUNTER
P/O PROCESSOR BOARD
ANALOG TO DIGITAL CONVERTER SUBSYSTEM
PLL ERROR DETECT
SWALLOW COUNTER & CONTROL
REFERENCE FREQUENCY SIGNAL
X16 FREQUENCY MULTIPLIER
PULSE COUNTER
16
OUTPUT BUFFER
8
REFERENCE FREQUENCY CHANNEL

Figure 8-B-19. 5508A Counter Board A3 Block Diagram

Figure

5508A A2 PROCESSOR BOARD 0550

(See Page

8-B-110. 5508A A3 COUNTER BOARD

8-B-111. Service information for the Counter Board is organized as follows:

a. Block Diagram Desciption in Paragraphs 8-B-112 through 8-B-119.

b. Counter Control Circuit Theory in Paragraphs 8-B-120 through 8-B-145.

c. Reference Frequency Channel and Measurement Frequency Channel Circuit Theory in Paragraphs 8-B-146 through 8-B-166.

d. Troubleshooting Procedures for the Control Circuits, Reference Frequency Channel, and Measurement Frequency Channel in Paragraphs 8-B-167 through 8-B-227.

e. Analog Subsystem Circuit Theory in Paragraphs 8-B-228 through 8-B-266.

f. Analog Subsystem Troubleshooting in Paragraphs 8-B-267 through 8-B-326.

8-B-112. 5508A A3 COUNTER BOARD BLOCK DIAGRAM DESCRIPTION

8-B-113. Counter Board A3 contains a Counter section and an Analog Subsystem. The Analog Subsystem is an 8-channel Analog-to-Digital Converter. The Counter section consists of Counter Control circuitry and two identical Frequency Channels. The Counter Board Block Diagram is shown in Figure 8-B-19.

8-B-114. The Measurement and Reference Frequency Channels process the incoming signals in the same way. The input frequencies are first multiplied by 16 by phase-locked loop (PLL) circuits. Each PLL output serves as a clock signal to the Pulse Counter and Swallow Counter and Control blocks. The Output Buffers are used to transfer the Pulse Counter contents to the data bus.

8-B-115. The primary function of the Counter section is to detect the difference in the number of cycles of transition that occur between the measurement frequency signal and the reference frequency signal. Before the cycles are counted, phase locked loops multiply the input frequencies by 16 in order to extend the resolution of the laser measurement. Both channels have a pulse counter that records each cycle of the respective phase locked loop output by clocking on each low to high transition.

8-B-116. When the Measurement Optics are at rest, the measurement frequency equals the reference frequency. Under this condition, the difference in cycles of transition is zero and the pulse counters do not accumulate a difference in count. When the Measurement Optics move during a measurement, the measurement frequency increases or decreases depending on the direction of movement. This causes the counter contents to differ. When either pulse counter is half full, an interrupt signal is sent to the MPU. The MPU responds to the interrupt by reading the Counter contents and determining any difference by subtraction.

8-B-117. The PLL outputs are also sent to the Swallow Counter and Control circuits. The function of these circuits is to keep the two pulse counters synchronized during a data transfer (SAMPLE) to the Processor Board. Upon receipt of a sample command from the MPU Control and Interface block, these circuits issue control signals to their respective Pulse Counters. During the next 15 cycles of the Pulse Counter input, the control signals cause the Pulse Counters to halt and then transfer their accumulated counts to the Output Buffers, then reset to zero, and then resume counting until the next sample command is received.

8-B-118. The contents of the Output Buffers transfer over the MPU Data Bus to the Processor Board where the difference count is determined and added to a portion of the R/W memory called the Software Counter. This counter resets to zero whenever the RESET key on the 5508 front panel is pressed. At a given instant, the Software Counter contains the phase difference (in units of 1/16 of a cycle) between the measurement and reference frequency signal that has accumulated between the time of the most recent Sample Command and the time when the RESET key was last activated. This number forms the basis for all of the laser measurements.

8-B-119. In order to properly transfer the contents of the Pulse Counters to the Software Counter, both the Pulse Counters are halted for the same number of input cycles but not necessarily for the same amount of time. Consequently, the pulse counts accumulated during the sampling process need not be taken into account because they would be cancelled by subtraction anyway.

8-B-120. 5508A A3 COUNTER CONTROL CIRCUIT THEORY

8-B-121. Paragraphs 8-B-122 through 8-B-145 contain circuit theory for the counter control circuits on A3. Troubleshooting information is covered in Paragraphs 8-B-167 through 8-B-227.

8-B-122. The schematic diagram for the control circuits is shown in Figure 8-B-21 sheet 1. The schematic has functional blocks that are labeled alphabetically with circled letters. These labels correspond to the circled letters in the text for the circuit theory.

8-B-123. The counter control circuits consist of External Record circuits, External Reset circuits, Address Decode, Power Distribution, Test Latches, Test F/F, Error Latches, Identity Interrupt, Control Counter, and NMI Generator and ECL References. Overall, the counter control circuits provide an interface with the microprocessor to control the counters.

8-B-124. Input Address and Control Signals

8-B-125. The following Address and Control inputs from the Processor board comprise the inputs to ADDRESS DECODE Ⓒ and IDENTIFY INTERRUPT Ⓗ:

a. A0 and A1 at J1-3 and J1-1 respectively. These are the lowest two bits of the Address Bus.

b. $\overline{\text{FE1}}$ at J1-25 (Block H) which is decoded from certain bits of the address bus. $\overline{\text{FE1}}$ is true when the Processor addresses memory locations $0024, $0025, $0026 and $0027.

$ indicates that the number following is hexadecimal

c. $\overline{\text{FE2}}$ at J1-23 (Block C) which is decoded from certain bits of the address bus. $\overline{\text{FE2}}$ is true when the Processor addresses memory locations $0020, $0021, $0022, and $0023.

d. R/$\overline{\text{W}}$ at J1-43 (Block C). This is the Read/Write control signal from the Processor board.

e. $\overline{\text{E}}$ at J1-47 (Block C), the 1 MHz clock from the Processor Board.

f. $\overline{\text{RESET}}$ at J1-49 (Block I). This becomes active at power on or whenever the MASTER RESET switch, A2S2, is pressed.

8-B-126. Note that $\overline{\text{E}}$,R/$\overline{\text{W}}$, A0, and A1 also go to the Analog Subsystem shown on sheet 4 of the schematic. These signals and the supply voltages are the only signals shared by the counter portion and the Analog Subsystem portion of this board.

8-B-127. Address Decode Ⓒ

8-B-128. The address decoder, consisting of U20 and U27, serves to decode the A0, A1, and R/$\overline{\text{W}}$ (read/write) inputs into one of eight outputs. The R/$\overline{\text{W}}$ input determines whether U27 is in the read or write mode. For counter data transfer (read) operations, the Processor sets R/$\overline{\text{W}}$ high. For counter control (write) operations, the processor sets R/$\overline{\text{W}}$ low.

8-B-129. U27 has two sets of output lines. One set for read and one set for write. Output pins 7, 9, 10, and 11 provide enable signals for the counter output buffers during read operations. The other output set, pins 12, 13, 14 and 15 provide control signals during write operations. A0 and A1 determine which line of a set is true.

8-B-130. When the Processsor Board reads the measurement channel output buffers (see sheet 3, block O), U27-10 and U27-11 become active in sequence. Similarly, U27-7 and U27-9 become active when the reference channel output buffers are read (see sheet 2 block T). These buffers contain the most recent values of the Pulse Counters and allow for proper transfer to the Processor Board over the data bus.

8-B-131. When the Processor sends the SAMPLE command to the Counter Board, decoder output U27-15 goes low and drives inverter U28A. Resistor network R34, R38, and R39 converts the TTL level to ECL. SAMPLE connects to both the measurement channel and reference channel Swallow Counter and Control blocks on sheets 2 and 3 where it initiates the sampling of the Pulse Counters and starts the process to update the Software Counter. JMP3 facilitates testing.

8-B-132. Test F/F, Error Latches, Test Latches Ⓕ Ⓖ Ⓔ

8-B-133. During Self-Test, the Processor sends a write command that causes U23 pins 9 and 8 to be set and reset respectively. The latch output is used to test both the Error Latches U29 and U22 and Test latches U23A and U30B. The output of U23 pin 9 is also converted to ECL and aids in troubleshooting the Swallow Counters. During normal operation, the output of the Test F/F is reset, i.e., U23-9 is low.

8-B-134. Control Counter Ⓘ

8-B-135. The Counter Control block is also configured by Processor write ($R/\overline{W}$) operations. When U27 pin 14 is true D4, D5, D6, and D7 of the data bus are clocked into register U19. The output bits of U19 have the following functions:

a. $\overline{\text{CLR LATCHES}}$ at U19-10 clears Error Latches U29 and U22 and the Test Latches U23A and U30B.

b. CLR LOL ERROR at U19-7 clears flip flops U5 and U49 (sheets 2 and 3). These flip flops detect loss-of-lock errors in the phase-locked loops. Resistor network R14 through R16 translates the output of U19 pin 7 to ECL.

c. TEST PLLS at U19-2 enables the 1MHz clock as an input to the phase-locked loops (sheets 2 and 3) during self test and troubleshooting. TEST PLLS is low during normal operation.

d. NMI MASK at U19-15 is discussed below in conjunction with INHIBIT NMI.

8-B-136. The counter board requires the attention of the Processor when the Pulse Counters approach overflow, or when an error develops, or an external sample command (see block A) is received. This is accomplished via the Nonmaskable Interrupt (NMI) line of the Processor. There are times, however, such as during power-on or trouble shooting, when it is necessary to ignore these interrupt requests. This is done by hardware masking out the interrupt with INHIBIT NMI.

8-B-137. INHIBIT NMI appears at U28 pin 8 and becomes active from two independent sources. The first is under software control and is called “NMI MASK” which comes from the Control Register U19-15. The second is the latch output U30-5 which is set whenever RESET becomes active and is reset as soon as the first sample pulse is received.

8-B-138. NMI Generator and ECL References Ⓙ

8-B-139. As mentioned under INHIBIT NMI above, whenever the Counter Board requires the attention of the Processor, the signal NMI becomes active. This occurs under the following conditions providing INHIBIT NMI is not active:

a. An overflow signal is received at U21-2 (Block J) from the Measurement Pulse Counter or at U21-3 from the Reference Pulse Counter.

b. One or more of the Phase-locked Loop Error Latches U29A or B or U22A or B is activated. See Block G.

c. An External Record signal activates latch U23A. See Block E.

8-B-140. Note that when the External Reset latch U30B (Block E) is activated it does not cause an $\overline{\text{NMI}}$ but instead activates the signal IN7 at U30B pin 8. IN7 connects to the interrupt decoder (Block A of Figure 8-B-18) of the Processor Board via J1-28.

8-B-141. Once the Processor has received either a Maskable or Nonmaskable Interrupt request it must identify the source or sources of these signals. For the Counter Board, this is accomplished by the Processor reading the memory location STAT = 0024. This causes the tristate buffer U26 (Block H) to transfer the signals present at its input onto the data bus.

8-B-142. The reference voltage VBB is generated at U25 and buffered by voltage followers U31A and B. The value of VBB, which lies halfway between the ECL high and low logic levels, serves as a reference for the comparators which translate ECL to TTL. The numerical value of VBB is referenced to the +5 V supply rather than ground and should be 1.29 V less than the actual value of this supply. For example, if the +5 V supply is actually +5.10 volts, then VBB with respect to ground is 3.81 V.

8-B-143. External Record and External Reset Ⓐ Ⓑ

8-B-144. When either the External Record or External Reset switch in the Remote Box is pressed, the signals enter the rear panel of the 5508A and connect to the Counter Board at pins J2 pin 23 (Block A) or J2 pin 24 (Block B). Each of these signals pass through a network of resistors, diodes, and capacitors which serves to improve noise immunity and protect the IC's from high voltage spikes.

8-B-145. The External Record signal activates one shot U6 whose output causes pin 6 of latch U23 to go low which in turn generates a Nonmaskable Interrupt. The External Reset signal passes through two buffer inverters U20E and U20D to set latch U30B which in turn generates a normal Processor interrupt via IN7.

8-B-146. 5508A A3 REFERENCE FREQUENCY CHANNEL AND MEASUREMENT FREQUENCY CHANNEL CIRCUIT THEORY

8-B-147. Paragraphs 8-B-148 through 8-B-166 contain circuit theory for the reference and measurement frequency channels on A3. Troubleshooting information is covered in Paragraphs 8-B-167 through 8-B-227.

8-B-148. The schematic diagrams for these circuits are shown in Figure 8-B-21 sheets 2 and 3. The schematics have functional blocks that are labeled alphabetically with circled letters. These labels correspond to the circled letters in the text for the circuit theory.

8-B-149. The circuitry associated with the measurement frequency channel is shown on sheet 3 of the schematic diagram, Figure 8-B-21. The circuitry for the reference frequency channel is shown on sheet 2. Since the processing for these two signals is identical, only the circuitry for the Measurement Channel is decribed here. However, when specific IC's and pins are mentioned, the corresponding point of the reference channel circuits will be included in parenthesis. When specifying a signal that exists in both channels, such as MLPYD FRQ, it will generally be left to context to determine which channel is appropriate.

8-B-150. X16 Frequency Multiplier Ⓚ Ⓟ

8-B-151. In order to extend the resolution of the basic measurement, phase-locked loops are used to multiply the frequencies of both the measurement and reference signals by 16. The loop feedback action is as follows. The output frequency of the loop, MLPYD FRQ, appears in differential form at U12 (U44) pins 8 and 9 and is proportional to the differential voltage at U12 (U44) pins 3 and 2.

8-B-152. The loop output frequency connects to U11 (U43) pin 12, where after being divided by 16, it appears at U11 (U43) pin 2 (CTRLD FRQ) and U18 (U38) pin 9, the V input of the Phase Detector. The R input of the Phase Detector U18 (U38)-6 is driven by the input frequency to the loop, SEL FRQ, which appears in differential form at U12 (U44) pins 11 and 12. This signal is normally the MEAS (REF) frequency but in test mode becomes the 1MHz CLK.

8-B-153. When the phase of the signal at the V input lags that of the signal at the R input, positive pulses are produced at the U output of U18 (U38) pin 4. The width of these pulses is proportional to the phase error. Similarly, positive pulses are produced at the D output of U18 (U38) pin 11 when the phase of the V input leads that of the R input.

8-B-154. These correction pulses are smoothed by a loop filter and fed back to U12 (U44) pins 3 and 2 to change the output frequency at U12 (U44) pins 8 and 9 in the direction necessary to remove the original phase error. The end result of the feedback loop is a stable output frequency that is 16 times that of the input. Finally, the output of the PLLs, MLPYD FRQ is buffered by U25 to form the signal MEAS (REF) CLK which becomes the input of the Pulse Counters and Swallow Counters.

8-B-155. The network of discrete components in front of U12 (U44) at pins 18 and 19 serves to terminate the MEAS (REF) signal cable and provide low-pass filtering for noise pulses.

8-B-156. PLL Error Detect Ⓛ (Ⓠ)

8-B-157. The circuitry in the PLL Error Detect block responds to two different error conditions in the PLL output signal MLPYD FRQ. The first condition occurs whenever the MEAS (REF) signal drops out for more than a few milliseconds. This might happen if an open circuit developed in the cable, or if the laser beam is blocked. This condition is detected by retriggerable one shot U32A (B). U32A (B) is normally in the high state as a result of the triggers received from the buffered version of the input signal at U12 (U44) pin 13. When the input signal drops out, the one shot returns to the low state within a few milliseconds and activates the Error Latches on sheet 1 of the schematic.

8-B-158. The second condition occurs when the PLL oscillator in U12 (U44) is unable to track the input signal due to excessively high or low frequencies or because of an excessive rate of frequency change. When this occurs, the normally narrow phase-correction pulses appearing at U18 (U38) pin 4 or 11 start to increase in width. When they reach half a cycle in width, U5 (U49) pin 15 or 2 latches in an ECL high state. U14 translates the LOL ERROR from ECL to TTL and connects to the Error Latches on sheet 1 of the schematic. LOL ERROR activates DS1. Note that signal conditions which activate a beam block error will also activate an LOL error but the converse is not necessarily true.

8-B-159. Pulse Counters Ⓜ (Ⓡ)

8-B-160. The Pulse Counter, a 16-bit, binary up counter, counts the MEAS (REF) CLK between Sample Commands received by the Swallow Counter & Control. When a Sample Command is received, the Swallow Counter issues control pulses to U10 (U42) pins 9 and 7. This causes the Pulse Counter to stop and hold its contents during the period required to transfer the contents to the Output Buffers, then to reset to zero, and then to resume counting.

8-B-161. In order to process the high frequencies of the MEAS (REF) signal, ECL logic is used for the first 4 bits of the Phase Accumulator, U10 (U42). U15 (U35) translates the outputs of U10 to TTL levels. The most significant bit, TTL CLK at U15-3 (U35-13), drives the remaining three 4-bit TTL counters. U16 (U36) decodes the state which resets the ECL front end. After passing through ECL to TTL translator U14 (U34), the decoded output of U16 clears the 12 bits of TTL counters U1, 2 and U8 (U40, U45, U46).

8-B-162. Swallow Counter and Control Ⓢ Ⓝ

8-B-163. The Swallow Counter and Control block receives the MEAS (REF) CLK from the X16 Frequency Multiplier at U4-13 and the Sample Command at U9-6 from the MPU Control and Interface. This block supplies the S1 and S2 control lines to the Pulse Counter inputs at U10 pins 9 and 7 respectively. Also, TTL LOAD at U14 pin 5 is supplied to the Output Buffers.

8-B-164. Except for the period during the 15 clock cycles following the receipt of a Sample Command, all outputs and internal registers of the Swallow Counter remain in the low state except for U17 (U37) pin 14 which remains in the high state. During the 15 clock cycles following the receipt of a Sample Command, a sequence of pulses propogates down and around the flip-flop chain of the Swallow Counter. This results in the outputs having the following sequence of values:

a. S1, S2 remain low and high respectively during the first three clock cycles following the receipt of the Sample Command. This results in the Pulse Counter continuing to increment.

b. S1, S2 go to the high and high state respectively during the 4th through 8th clock cycles. This causes the Pulse Counter to halt and retain the value reached during the 3rd clock cycle.

c. S1, S2 go to the low and low state respectively during the 9th through 12th clock cycles. This clears the Pulse Counter.

d. S1, S2 go to the high and high state respectively during the 13th clock cycle causing the Pulse Counter to remain in the cleared state.

e. S1, S2 return to the low and high state respectively during the 14th and following clock cycles until another Sample Command is received and the entire cycle is repeated.

8-B-165. TTL LOAD, which is the other output of the Swallow Counter, goes high during the 7th clock cycle following the Sample Command and serves to clock the contents of the Pulse Counter into the Output Buffers. TTL LOAD returns to the low state at the beginning of the 16th clock cycle.

8-B-166. The TEST COUNTERS signal at U3-11 is always low during normal operation. It goes high during some test modes to inhibit feedback paths to faciltate troubleshooting. Also JMP1 (JMP4) is removed for the same reason during some test modes.

8-B-167. TROUBLESHOOTING PROCEDURES FOR A3 CONTROL CIRCUITS, REFERENCE FREQUENCY CHANNEL, AND MEASUREMENT CHANNEL

8-B-167a. TTL and ECL Logic Levels

8-B-167b. The Counter Board uses two families of logic, TTL and ECL. The family that a particular signal or IC belongs to is usually indicated on the schematic, or in this test procedure, or on the circuit board silkscreen. If not, you can usually determine the family type by the manufacturers' part number, a 7400 series is TTL, and a 10000 series is ECL.

8-B-167c. The TTL logic levels are conventional and the preset thresholds on the 5005A may be used when measuring a TTL signal. However, the ECL circuitry is operated between +5.1V and ground rather than between the more conventional ground and -5.2V. The resulting ECL logic levels are as follows (if the actual value of the +5V supply is 5.10 Volts):

ECL High = >4.0 Volts

ECL Low = <3.6 volts

8-B-167d. If the +5V supply is other than 5.10 volts, then these levels are shifted by the same amount that the +5V supply differs from 5.10 Volts.

CAUTION

DO NOT SHORT ECL SIGNALS TO GROUND. DAMAGE TO THE DRIVER MAY RESULT.

8-B-167e. Setting ECL Threshold on the 5005A

8-B-167f. Before using the 5005A in the following tests, set the ECL thresholds as follows:

a. Measure the +5V supply and note this value as V+MEAS.
Typically, V+MEAS = 5.1 Volts.

b. Set Data H Threshold to V+MEAS - 1.1 Volts.
Typically, Data H = 4.00 Volts.

c. Set Data L Threshold to V+MEAS - 1.5 Volts.
Typically, Data L = 3.60 Volts.

d. Set Clock Threshold to V+MEAS - 1.3 Volts.
Typically, Clock Threshold = 3.80 Volts.

e. Set ST-SP-QL Threshold to same value as Clock Threshold in (d.) above.

8-B-168. Data Probe Grounds on the 5005A

8-B-169. Under most conditions, the ground lead on the Timing Pod of the 5005A provides an adequate ground for the Data Probe. However, if difficulties are experienced obtaining stable signatures or precise frequency readings, try connecting the Data Probe ground lead to a ground test point near the data source. This will be particularly true for tests which do not require that the Timing Pod be connected.

8-B-170. Standard Troubleshooting Procedures

8-B-171. In the following tests, reference is frequently made to "localize the defective element by standard troubleshooting procedures". This consists of the following:

a. The test procedure places a group of IC's in a definite state and:

    1. provides the correct values of the input and output signals characteristics

        OR

    2. implies use of the schematic to determine the signal characteristics

        OR

    3. simply states a suspected component

b. When the test procedure specifies a suspected component, replace it and run the test again.

c. When signal characteristics are known, measure the signals until a component is found that has correct inputs but erroneous outputs. Most likely this component is defective. If not, check for:

    1. output loading such as a board short

    2. shorted input on a downstream circuit

    If inputs are incorrect, check for open traces and faulty outputs from previous stages.

d. If an erroneous signal comes from another board, perform the test procedure for the suspected board.

e. If a through d does not locate the problem, randomly replace parts in the isolated area until the problem is fixed.

8-B-172. Order of Tests

8-B-173. If the first symptoms observed are sufficient to isolate trouble to a board function, consult the Menu of Tests and Purpose of Test headings to decide on the first test to perform. Otherwise, perform the following tests in the order given. In either case, always perform Test 1.

8-B-174. Menu of Tests

Test 1: Preliminary Tests — Paragraph 8-B-175
Test 2: MPU Interface and Control — Paragraph 8-B-179
Test 3: X16 Frequency Multipliers — Paragraph 8-B-185
Test 4: Pulse Counters and Swallow Counters —- Paragraph 8-B-193
Test 5: Error Detectors, External Record, and External Reset — 8-B-199
Test 6: Status Buffer (U26) — Paragraph 8-B-205
Test 7: Output Buffers — Paragraph 8-B-209
Test 8: Not Used
Test 9: Pulse Counters — Paragraph 8-B-214
Test 10: Swallow Counters — Paragraph 8-B-221

NOTE

During the following tests, when an item exists in both the MEAS and REF channels, the REF value is given in parenthesis. However, named signals such as MLPYD FRQ generally rely on context to determine whether the MEAS channel MLPYD FRQ or the REF channel MLPYD FRQ is under consideration. MEAS channel components and signals are on the left side of the board and the REF channel elements are to the right of center.

8-B-175. Test 1. Initial Checks and Preliminary Procedures

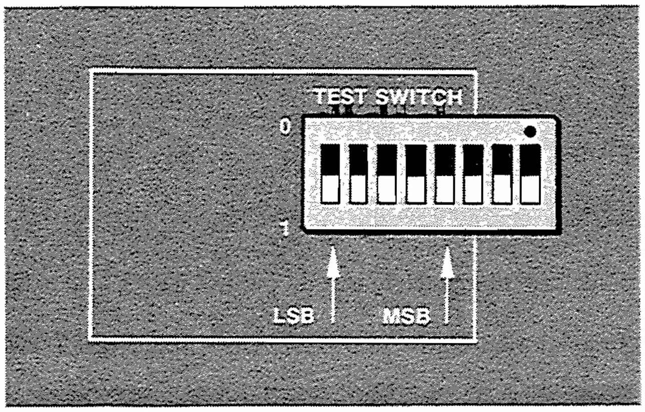
8-B-176. Purpose of Test

8-B-177. Test 1 determines basic or obvious problems and provides preliminary procedures for the other tests.

8-B-178. Procedure

a. Check that A3 Jumpers JMP 1, 2, 3, and 4 are properly installed in the NORM positions.

b. Check that TEST SWITCH A2S3 is set as shown below.



c. Visually inspect the board for broken traces, solder bridges, foreign bodies, mechanically damaged components, etc.

d. Check that the two edge connectors are secure.

e. Measure the +5 V line at TP21, TP38, or TP41, it should be between 5.0 V and 5.2 V, typically 5.1 V.

f. Measure U31-8 to confirm that the +15 V supply is between 14.6 V and 15.4 V.

g. Check U31-1 and 7 to confirm that VBB1 and VBB2 measure between 1.23 V and 1.35 V (at normal temperatures) below the measured value of the +5 V supply. (The Delta V mode of the 5005A is very convenient here.) If not, see sheet 1 of the schematic Figure 8-B-21 and localize the defective element by standard troubleshooting procedures. Note that U25-9 should also be in this same voltage range.

8-B-179. Test 2. MPU Interface and Control

8-B-180. Purpose of Test

8-B-181. This test provides performance verification and troubleshooting procedures for the MPU Interface & Control block shown on sheet 1 of the schematic except for the data paths associated with $\overline{\text{EXT RECORD}}$, $\overline{\text{EXT RESET}}$ and the Error Latches. Key signals verified include SAMPLE, $\overline{\text{LE1}}$, $\overline{\text{LE2}}$, $\overline{\text{LE3}}$, and $\overline{\text{LE4}}$.

8-B-182. Scheme of Test

8-B-183. The MPU exercises the inputs to this block and the output signatures are compared against their correct values.

8-B-184. Procedure

a. Remove Jumper JMP2. Leave other jumpers installed.

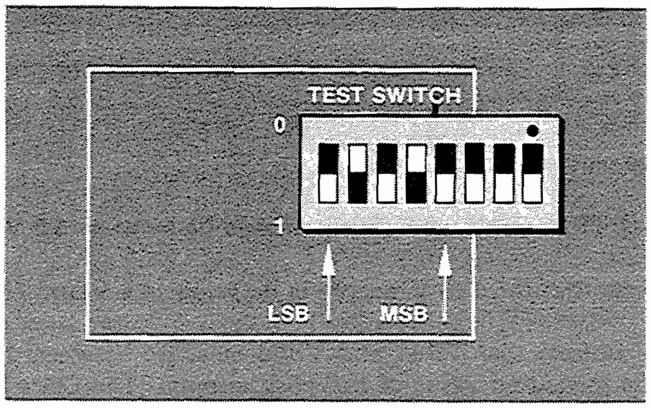
b. Connect Timing Pod of 5005A to test points on Processor Board A2 as follows:

   1. Black to ground
   2. Yellow to CLOCK TP9
   3. Red to STOP TP11
   4. Green to START TP10

c. Set 5005A Function to NORM, and all thresholds to TTL.

d. Set Clock and START polarities to negative and STOP polarity to positive.

e. Set TEST SWITCH A2S3 as shown below and push MASTER RESET switch S2.



f. Check that the signature of the +5 V line is AFH2 (TP 21, 38, or 41). If not, suspect Processor board first.

g. Confirm the following signatures:

U19-2	HFAF
U19-7	HFAF
U19-10	HFAF
U20-2	AFH2
U23-8	H7A0
U23-9	7C72
U27-7	PF77
U27-9	8F80
U27-10	0UU9
U27-11	A9U8
U28-2	52A9
U28-8	HFAF
U28-10	AP7P

h. If one or more signatures are incorrect, localize the defective element via standard troubleshooting procedures (see Paragraph 8-B-170) utilizing the following valid signatures and sheet 1 of the schematic. Note that the signatures are listed by the driving terminal of a node:

J1-1 (or U20-13)	3834
J1-3 (or U20-5)	58UF
J1-23 (or U27-4)	1CC2
J1-25 (or U21-8)	AP7P
J1-43 (or U27-3)	HH4H
J1-47 (or U20-1)	0000
J1-49 (or U30-4)	AFH2
U19-15	HFAF
U20-4	0000
U20-6	U42P
U20-12	94P6
U21-10	02AF
U21-13	707P
U27-12	5527
U27-13	13PF
U27-14	F926
U27-15	UP7C
U30-5	0000

i. While pressing MASTER RESET Switch A2S2, confirm that U30-5 goes to a TTL HIGH and then returns to LOW after release. If not, see sheet 1 of the schematic diagram.

j. Replace JMP2 in the NORM position and go to next test if this test reveals no defective elements. Otherwise, remove 5005A Timing Pod and restore TEST SWITCH to 00000000.

8-B-185. Test 3. X16 Frequency Multipliers

8-B-186. Purpose of Test

8-B-187. This test provides performance verification and troubleshooting procedures for the X16 Frequency Multipliers including signals inputs to the PLL Error Detect blocks.

8-B-188. Scheme of Test

8-B-189. The MPU activates the signal TEST PLLS which directs the 1.000 MHz Clock to the inputs of the phase-locked loops. In this condition, the output of the loops MEAS (REF) CLK should be 16.000 MHz. Since it is not practical to open the feedback loop and place the functional sub-blocks of the PLLs in definite states, the identification of defective components in a malfunctioning loop is more complex. For this reason a flow chart is provided as a guide to the procedure.

8-B-190. Limitations of the Test

8-B-191. This test does not verify the performance of the PLLs at the extreme operating frequencies. Also, the discrete component filter network and the line receiver portion of U12 (U44) are not exercised.

8-B-192. Procedure

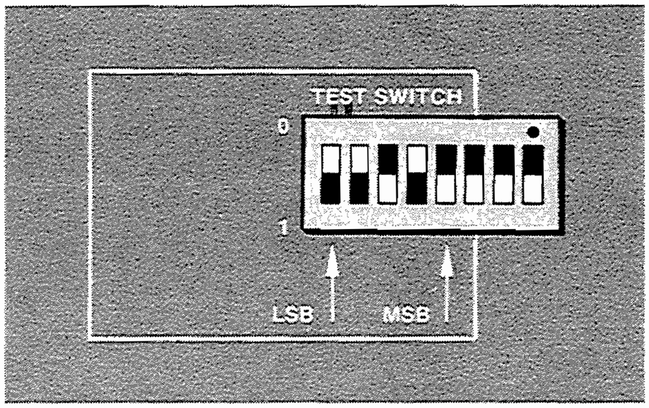
NOTE

> You may perform this test for both the MEAS and REF (items in parenthesis) channels simultaneously if desired.

a. On the 5005A, Set ECL Data threshold.

b. Remove JMP2, leave other jumpers installed.

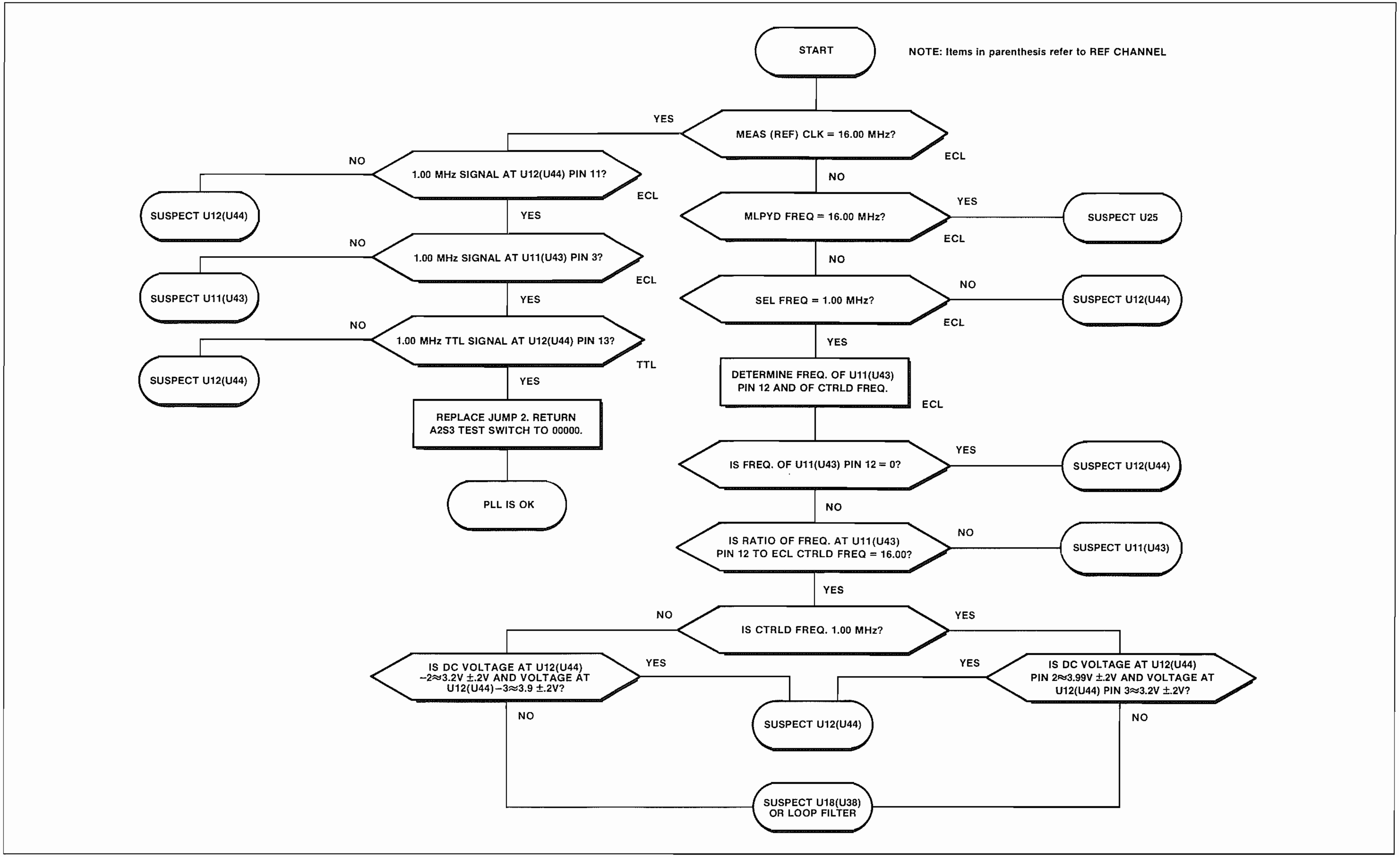
c. Set TEST SWITCH A2S3 as shown below.



d. Press MASTER RESET switch A2S2.

e. Confirm that U12-17 (U44-17) is a TTL HIGH, and that a 1.000 MHz TTL signal is present at U12-15 (U44-15). If not, go to Test 2.

f. Go to flowchart below. Read Paragraph 8-B-168 regarding Data Probe ground as it will aid in performing this test.


START
MEAS (REF) CLK = 16.00 MHz?
YES
ECL
NO
1.00 MHz SIGNAL AT U12(U44) PIN 11?
NO
ECL
SUSPECT U12(U44)
YES
1.00 MHz SIGNAL AT U11(U43) PIN 3?
NO
ECL
SUSPECT U11(U43)
YES
1.00 MHz TTL SIGNAL AT U12(U44) PIN 13?
NO
TTL
SUSPECT U12(U44)
YES
REPLACE JUMP 2. RETURN A2S3 TEST SWITCH TO 00000.
PLL IS OK
MLPYD FREQ = 16.00 MHz?
YES
ECL
SUSPECT U25
NO
SEL FREQ = 1.00 MHz?
NO
ECL
SUSPECT U12(U44)
YES
DETERMINE FREQ. OF U11(U43) PIN 12 AND OF CTRLD FREQ.
ECL
IS FREQ. OF U11(U43) PIN 12 = 0?
YES
SUSPECT U12(U44)
NO
IS RATIO OF FREQ. AT U11(U43) PIN 12 TO ECL CTRLD FREQ = 16.00?
NO
SUSPECT U11(U43)
YES
IS CTRLD FREQ. 1.00 MHz?
NO
YES
IS DC VOLTAGE AT U12(U44) −2≈3.2V ±.2V AND VOLTAGE AT U12(U44)−3≈3.9 ±.2V?
YES
NO
SUSPECT U12(U44)
IS DC VOLTAGE AT U12(U44) PIN 2≈3.99V ±.2V AND VOLTAGE AT U12(U44) PIN 3≈3.2V ±.2V?
YES
NO
SUSPECT U18(U38) OR LOOP FILTER

NOTE: Items in parenthesis refer to REF CHANNEL

Figure 8-B-20. 5508A A3 PLL Troubleshooting Flow Chart

Figure 8-B-20
5508A A3 PLL TROUBLESHOOTING FLOW CHART

(See Page 8-B-59)

8-B-193. Test 4. Phase Accumulators and Swallow Counters

8-B-194. Purpose of Test

8-B-195. Test 4 provides performance verification of both the Pulse Counter and Swallow Counter and the Control blocks.

8-B-196. Scheme of Test

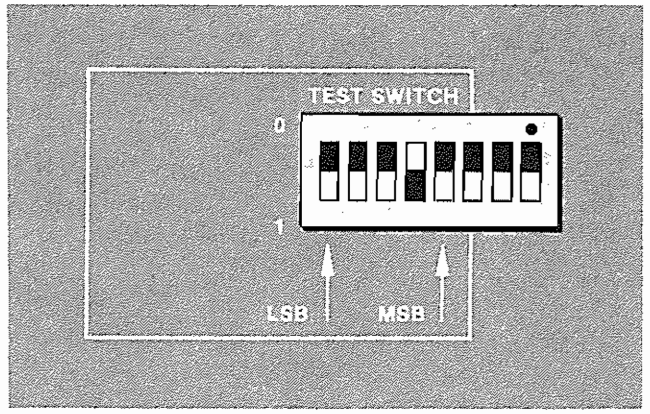
8-B-197. The most significant bit of the Pulse Counter is jumpered to the sample input of the Swallow Counter and Control block. When this bit goes active, the sampling process is initiated to place both blocks in a repetitive loop thereby allowing signature analysis to be performed.

8-B-198. Procedure

a. If present, remove the Laser Head cable.

b. Remove JMP2, 3. Leave other jumpers installed.

c. Set TEST SWITCH A2S3 as shown below.



d. On 5005A, set all ECL thresholds.

e. On 5005A, set Clock, Start, and Stop polarities to POSITIVE.

NOTE

Steps f through l check the MEASUREMENT channel.

f. Connect Timing Pod of 5005A as follows (use a DIP test clip):

1. Black to U17-8
2. Yellow to U17-9
3. Red to U17-5
4. Green to U17-2

g. Connect a short jumper from U28-9 to center terminal of JMP3.

h. Connect a short jumper from U1-11 to U9-6.

8-B-193. Test 4. Phase Accumulators and Swallow Counters

8-B-194. Purpose of Test

8-B-195. Test 4 provides performance verification of both the Pulse Counter and Swallow Counter and the Control blocks.

8-B-196. Scheme of Test

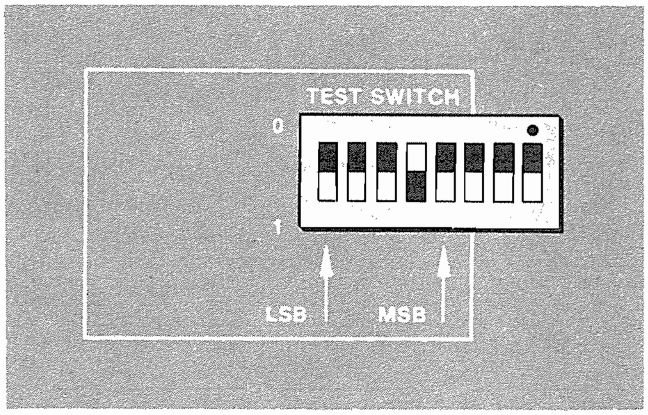
8-B-197. The most significant bit of the Pulse Counter is jumpered to the sample input of the Swallow Counter and Control block. When this bit goes active, the sampling process is initiated to place both blocks in a repetitive loop thereby allowing signature analysis to be performed.

8-B-198. Procedure

a. If present, remove the Laser Head cable.

b. Remove JMP2, 3. Leave other jumpers installed.

c. Set TEST SWITCH A2S3 as shown below.



d. On 5005A, set all ECL thresholds.

e. On 5005A, set Clock, Start, and Stop polarities to POSITIVE.

NOTE

Steps f through l check the MEASUREMENT channel.

f. Connect Timing Pod of 5005A as follows (use a DIP test clip):

1. Black to U17-8
2. Yellow to U17-9
3. Red to U17-5
4. Green to U17-2

g. Connect a short jumper from U28-9 to center terminal of JMP3.

h. Connect a short jumper from U1-11 to U9-6.

i. Press MASTER RESET Switch A2S2.

j. Confirm that the frequency of MEAS CLK (ECL) is >50 kHz and <4 MHz. If not go to Test 3.

k. Confirm that the total number of pulses (Totalize Function of 5005A) at MEAS CLK (ECL) is 32,782; and that the signature of +5 V is U9P4. If not go to Test 9.

l. Confirm the following TTL signatures. If a signature is not confirmed, fault is most likely in the IC driving the node. See sheet 2 of schematic to identify driver. If this is not the problem go to Test 9.

(MEAS) $\overline{\text{TTL CLR}}$ (TP5)	C8A2
(MEAS) TTL CLK (TP8)	UP96
(MEAS) TTL LOAD (TP9)	72C0

U7-3	7707
U7-4	577A
U7-7	HH86
U7-8	89F1
U7-13	AC99
U7-14	PCF3
U7-17	1180
U7-18	521H

U13-3	AP82
U13-4	FC39
U13-7	A374
U13-8	UP96
U13-13	C4C3
U13-14	AA08
U13-17	7211
U13-18	A3C1

NOTE

Steps m through s check the REFERENCE channel.

m. Move DIP test clip, if used, from U17 to U37 or else make following connections of Timing Pod:

1. Black to U37-8
2. Yellow to U37-9
3. Red to U37-5
4. Green to U37-2

n. Connect a short jumper from U28-9 to center terminal of JMP3, if not already in place.

o. Remove jumper from U1-11 to U9-6 and install jumper from U45-11 to center terminal of JMP3.

p. Press MASTER RESET switch A2S2.

q. Confirm that the frequency of REF CLK (ECL) is >50 kHz and <4 MHz. If not go to Test 3.

r. Confirm that total number of pulses (Totalize Function of 5005A) at REF CLK (ECL) is 32,782; and that the signature of +5 V is U9P4. If not go to Test 9.

s. Confirm the following TTL signatures. If a signature is not confirmed, the fault is most likely the IC driving the node. See schematic. If this is not the problem go to Test 9.

(REF) $\overline{\text{TTL CLR}}$ (TP33)	C8A2
(REF) TTL CLK (TP32)	UP96
(REF) TTL LOAD (TP26)	72C0

U39-3	7707
U39-4	577A
U39-7	HH86
U39-8	89F1
U39-13	AC99
U39-14	PCF3
U39-17	1180
U39-18	521H

U33-3	AP82
U33-4	FC39
U33-7	A374
U33-8	UP96
U33-13	C4C3
U33-14	AA08
U33-17	7211
U33-18	A3C11

t. Remove all jumper wires and Timing Pod.

u. Reinstall JMP2, 3.

v. Restore TEST SWITCH A2S3 to 00000000.

w. Go to Test 5 if this test has revealed no defective components.

8-B-199. Test 5. Error Detectors, External Record, and External Reset

8-B-200. Purpose of Test

8-B-201. Test 5 provides performance verification and troubleshooting of the Beam Block and LOL (Loss-of-Lock) Error Detect circuits, and associated data paths to the Processor Board A2 for both the MEAS and REF channels. In addition, the External Record and External Reset circuitry, and the gates used to generate NMI are checked.

8-B-202. Scheme of Test

8-B-203. The Processor Board A2 activates control signals on the A3 Counter Board to switch the input to the Frequency Multipliers on and off. This condition activates the error detect circuits.

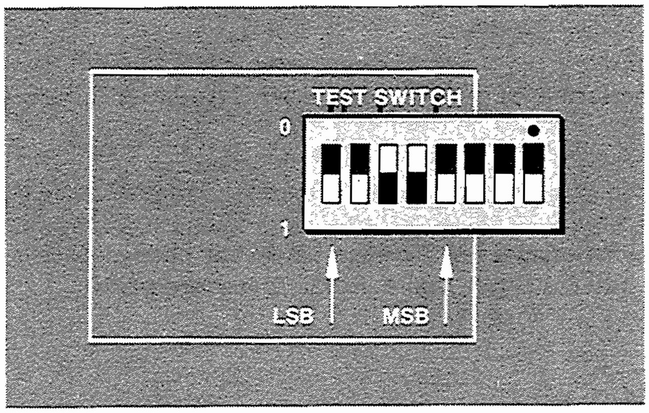
8-B-204. Procedure

a. If present, remove Laser Head Cable.

b. Connect Remote Control Unit 05508-60021 to the rear panel connector of the 5508A.

c. Remove JMP2, 3. Leave other jumpers installed.

d. Set TEST SWITCH A2S3 as shown below and push MASTER RESET switch A2S3.



e. Make sure Timing Pod of 5005A is grounded. Set Function to NORM and use Data Probe as a logic probe for next step.

f. Verify that the TTL signal at U24-8 toggles at about a 1 Hz rate and likewise for the signals at U24-1,2,3,4. If not, the trouble may be localized by tracing the erroneous signal back through the Error Latches to its origin in the PLL Error Detect block. See sheet 2(3) of the schematic diagram Figure 8-B-21. Also, verify that the two red LEDs are flashing at about a 1 Hz rate.

NOTE

If one of the above signals is not toggling and Tests 2 and 3 have not been performed, then do so to ensure that the inputs to the circuity tested here are correct.

NOTE

This test does not verify the ability of the LOL Detectors to respond to excessively high frequency MEAS and REF signals.

g. On the Remote Control Unit, press the RECORD switch and verify that U23-6 changes state. Press the RESET switch and verify that U30-8,9 change state. (The duration of the state change for the above three signals varies randomly but averages about one second.) If not, troubleshoot as indicated by sheet 1 of the schematic utilizing standard trouble shooting procedures. Note that the above signals originate, in a straight-line fashion, from the Remote Control Unit. If trouble shooting is required, be sure that Test 2 passes in order to ensure that the inputs to the circuitry tested here are correct.

h. Verify that the TTL signals at U21-2,3 are toggling. If not perform Test 4.

i. Verify that 0 VINT alternates between toggling and a TTL low at about a 1 Hz rate. If not, suspect U21, U28.

j. Verify that U28-5 alternates between toggling and a TTL high at about a 1 Hz rate. If not, suspect U21. See sheet 1 of the schematic. Note that U28-6 is not checked by this procedure because it has no resistive pullup when JMP2 is removed. If NMI does not work when this point is reached (MPU fails to respond to Counter Board), suspect U28. See sheet 1 of the schematic.

k. Replace JMP2 and 3 and restore TEST SWITCH A2S3 to 00000000.

8-B-205. Test 6. Status Buffer (U26)

8-B-206. Purpose of Test

8-B-207. Test 6 verifies the performance of the Status Buffer U26. A U26 failure would most likely be indicated by:

a. Failure of 5508A to respond to External Reset or External Sample but Test 5 of this procedure passes or

b. Failure of 5508A display to change in Distance Mode but change does occur in Velocity Mode when retroreflector is moved, but Tests 1, 2, and 4 of this procedure passes.

8-B-208. Procedure

a. Remove JMP2. Leave other jumpers installed.

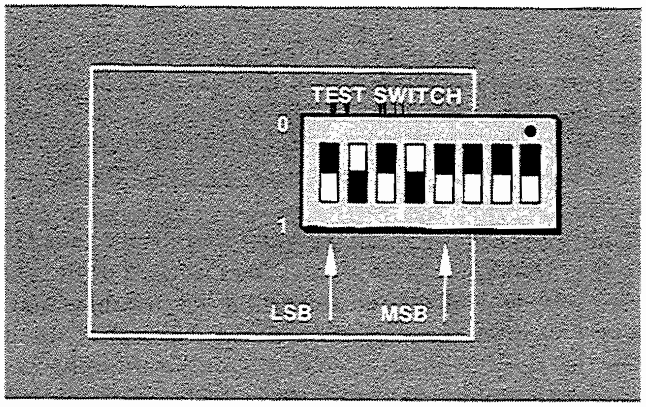
b. Connect Timing Pod of 5005A to test points on the Processor Board A2 as follows:

1. Black to ground
2. Yellow to CLOCK TP9
3. Green to START TP10
4. Red to Counter Board U28-10 (use jumper if necessary)

c. On 5005A, set Function to QUAL, and all thresholds to TTL.

d. Set Clock, Start and Qual polarities to negative. Set Stop polarity to positive.

e. Set TEST SWITCH A2S3 as shown below and push MASTER RESET switch A2S2.



f. Confirm that Signature of +5 V is 0003. If not, suspect Processor Board A2.

g. Confirm the following signatures:

U26-1	0000
U26-2	0001
U26-4	0001
U26-6	0001
U26-8	0001
U26-11	0001
U26-15	0003
U26-17	0002
U26-19	0000

If one or more of the above signatures is incorrect, perform Test 2, and then Test 5 if needed.

h. Confirm the following Signatures:

U26-3	0002
U26-5	0003
U26-9	0001
U26-12	0001
U26-14	0001
U26-16	0001
U26-18	0001

Also confirm that the signature at U26-13 is the same as that at U26-7.

If one or more of the measured signatures above is incorrect, suspect U26.

i. Remove 5005A Timing Pod, replace JMP2, and restore TEST SWITCH A2S3 to 00000000.

8-B-209. Test 7. Output Buffers

8-B-210. Purpose of Test

8-B-211. Test 7 is not a true test since the Output Buffers, U7, U13, U33, U39 are very difficult to verify. If an output buffer is defective, the symptoms most likely to appear are as follows:

a. Self-test 1 fails, as indicated by "FAIL1" on the 5508A display, but Tests 1, 2, 3 and 4 of this procedure pass. Change U7 first and then U13.

b. Self-test 2 fails, as indicated by "FAIL2" on the 5508A display, but Tests 1, 2, 3, and 4 of this procedure pass. Change U39 first and then U33.

8-B-212. Test 8. Not Used

8-B-213. Test 8 requires special factory test equipment and cannot be performed in the field.

8-B-214. Test 9. Pulse Counters

8-B-215. Purpose of Test

8-B-216. Test 9 provides performance verification and troubleshooting procedures for the Pulse Counter portions of the Counter Board. Perform this test only if Test 4 fails.

8-B-217. Scheme of Test

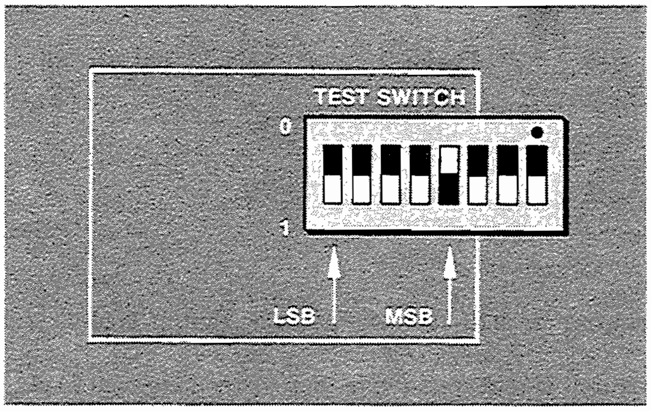
8-B-218. The Pulse Counters are placed in a mode to continually divide the X16 multiplied 1 MHz CLK and the outputs of the counter are checked for the correct frequencies.

8-B-219. Procedure

8-B-220. If either the MEAS or REF channel failed Test 4 perform this test for the failed channel. If both channels failed, perform this test for both simultaneously.

a. Remove JMP2 and 3. Leave all other jumpers installed.

b. Place TEST SWITCH A2S3 as shown below.



c. Press MASTER RESET Switch A2S2.

d. Make sure ground lead on Timing Pod of 5005A is grounded. Set ECL thresholds on 5005A.

e. Confirm that MEAS (REF) CLK is a 16.000 MHz ECL signal. If not, perform Test 3.

f. Confirm that U10(U42)-7 is an ECL high and that U10(U42)-9 is an ECL low. If not, perform Test 10.

g. Confirm that MEAS (REF) TTL CLR is a TTL high. If not, suspect U16, U14 (U36, U34). See Pulse Counter portion of schematic for troubleshooting.

h. Confirm the following TTL frequencies:

U13 (U33)-3	8.00 MHz
U13 (U33)-4	4.00 MHz
U13 (U33)-7	2.00 MHz
U13 (U33)-8	1.00 MHz

If the above are not present then confirm the following ECL frequencies:

U10 (U42)-14	8.00 MHz
U10 (U42)-15	4.00 MHz
U10 (U42)-2	2.00 MHz
U10 (U42)-3	1.00 MHz

If these are not present suspect U10 (U42). If these are present make sure VBB (see step 8 of Test 1) is present at U15 (U35)-2,6,10,14 then suspect U15 (U35).

i. Confirm the following TTL frequencies:

U13 (U33)-13	500 KHz
U13 (U33)-14	250 KHz
U13 (U33)-17	125 KHz
U13 (U33)-18	62.5 KHz

If these are not present suspect U8 (U40).

j. Confirm the following TTL frequencies:

U7 (U39)-3	31.25 KHz
U7 (U39)-4	15.63 KHz
U7 (U39)-7	7.81 KHz
U7 (U39)-8	3.91 KHz

If these are not present suspect U2 (U46).

k. Confirm the following TTL frequencies:

U7 (U39)-13	1.95 KHz
U7 (U39)-14	0.98 KHz
U7 (U39)-17	0.49 KHz
U7 (U39)-18	0.24 KHz

If these are not present suspect U1 (U45).

l. Replace JMP2, 3.

m. Return TEST SWITCH A2S3 to 00000000.

n. If a defective component has not been found in Test 9 then perform Test 10.

8-B-221. Test 10. Swallow Counters

8-B-222. Purpose of Test

8-B-223. Test 10 provides performance verification and troubleshooting of the Swallow Counter & Control portions of the Counter Board. Perform this test when Test 9 has failed.

8-B-224. Scheme of Test

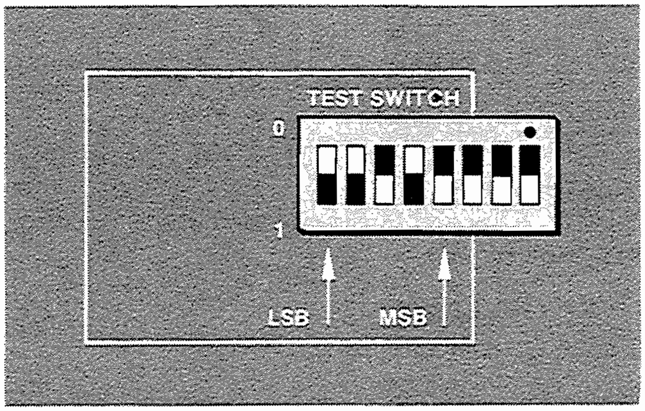
8-B-225. The X16 multiplied 1 MHz CLK drives the Sample input of the Swallow Counters while the internal feedback paths are disabled. This results in the input signal being divided and shifted about the circuitry. The output frequencies are then measured and compared against known good values.

8-B-226. Procedure (Items in parenthesis refer to REF channel)

8-B-227. If either MEAS or REF channel fails Test 4 perform this test for the failed channel. If both channels failed, do not perform this test for both simultaneously but rather check each sequentially.

a. Remove JMP1, 2, 3, 4.

b. Set TEST SWITCH A2S3 as shown below.



c. Set ECL thresholds on 5005A. Check that Timing Pod of 5005A is grounded.

d. Push MASTER RESET Switch A2S2.

e. Connect a short jumper from U9-6 to U9-11 (U41-6 to U41-11). A DIP Clip is convenient here.

f. Confirm that a 16.000 MHz ECL signal is present at MEAS (REF) CLK. If not, perform Test 3.

g. Confirm that U4-9 (U48-9) is a steady ECL high. If not, perform Test 2.

h. Confirm the following ECL frequencies:

U4-7 (U48-7)	8.000 MHz
U3-12 (U47-12)	8.000 MHz

If these are not correct, refer to the Swallow Counter & Control portion of sheet 2 (sheet 3) of the schematic and trace the erroneous signal to the defective element utilizing standard troubleshooting procedures and the following correct ECL frequencies:

U9-6 (U41-6)	16.000 MHz
U9-2 (U41-2)	8.000 MHz
U17-2 (U37-2)	8.000 MHz
U17-3 (U37-3)	8.000 MHz
U9-15 (U41-15)	8.000 MHz

i. Confirm the following ECL frequencies:

U17-15 (U37-13)	4.000 MHz
U17-14 (U37-14)	1.000 MHz
U17-4 (U37-4)	500 KHz

Similarly, if these are not correct, refer to the same portion of the schematic utilizing the following correct ECL frequencies and standard troubleshooting procedures.

U4-15 (U48-15)	2.000 MHz
U4-2 (U48-2)	1.000 MHz
U4-3 (U48-3)	500 KHz
U17-12 (U37-10)	4.000 MHz
U17-11 (U37-11)	1.000 MHz
U17-7 (U37-7)	500 KHz

j. Confirm that the frequency of MEAS (REF) TTL LOAD is 500kHz. If not, suspect U14 (U34) after checking that VBB is present at U14 (U34)-7.

NOTE

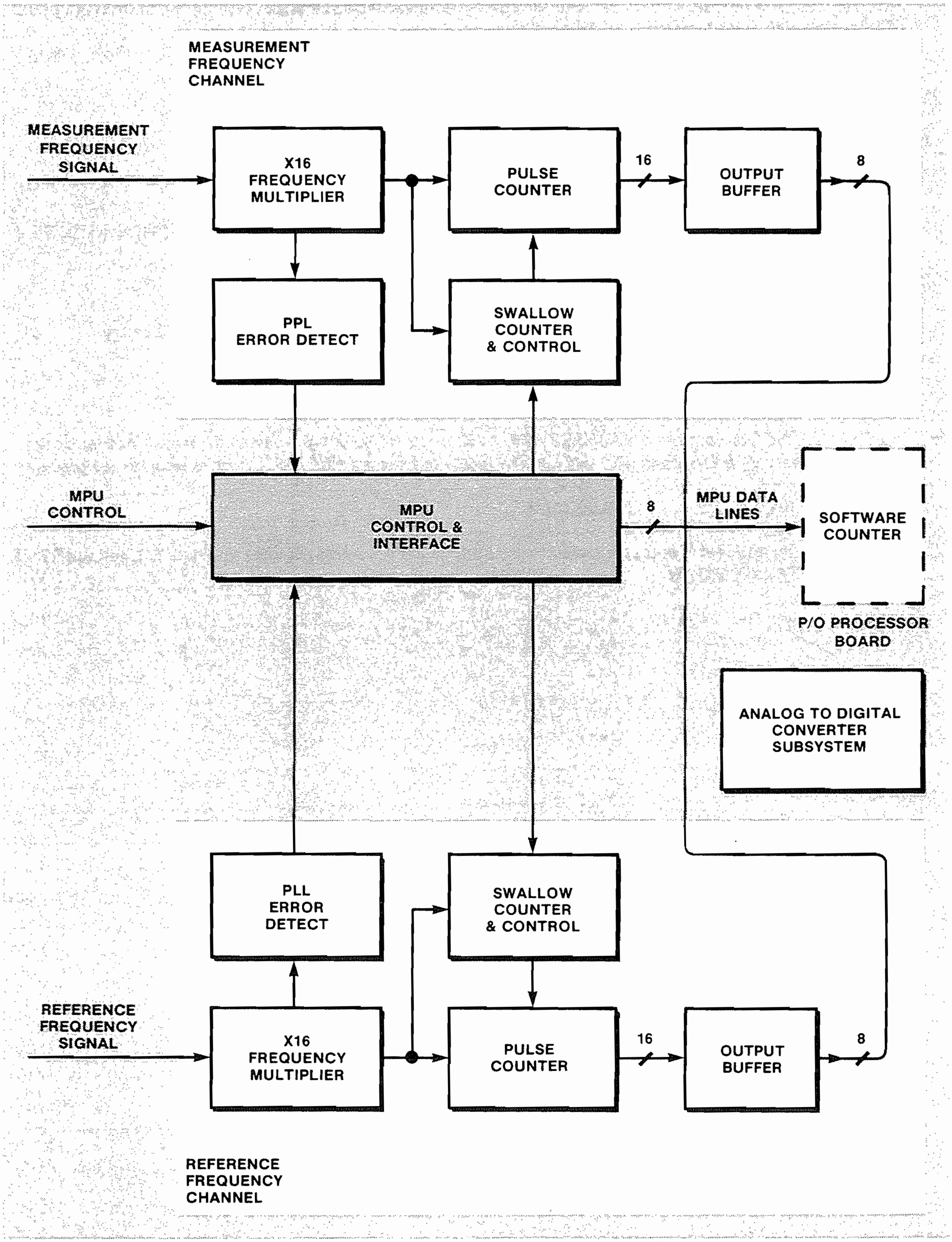
If Test 4 fails and this point is reached without identifying a defective component then try replacing IC's in the following order.

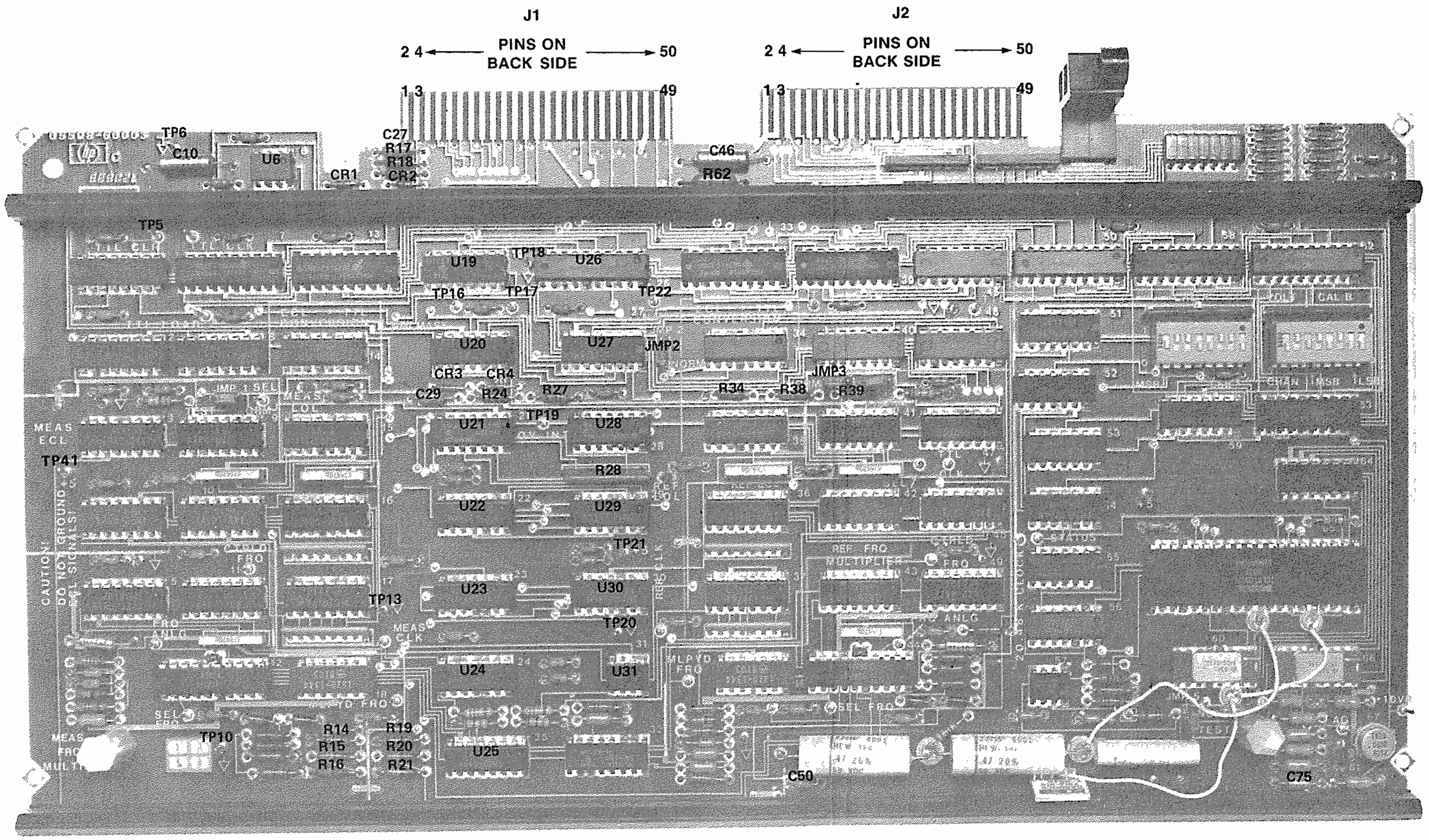
U3 (U47), U17 (U37), U4 (U48), U10 (U42), U8 (U40) and associated components.

k. Confirm that the frequency of MEAS (REF) TTL CLR is 1.00MHz. If not, refer to the Pulse Counter portion of sheet 2 (sheet 3) of the schematic and use the following correct ECL frequency to localize the problem.

U14 (U34)-1,2	1.00 MHz

l. Repeat for other channel if necessary, otherwise remove wire jumpers; replace JMP1, 2, 3, 4; restore TEST SWITCH A2S3 to 00000000.


MEASUREMENT FREQUENCY CHANNEL
MEASUREMENT FREQUENCY SIGNAL
X16 FREQUENCY MULTIPLIER
PULSE COUNTER
16
OUTPUT BUFFER
8
PPL ERROR DETECT
SWALLOW COUNTER & CONTROL
MPU CONTROL
MPU CONTROL & INTERFACE
8
MPU DATA LINES
SOFTWARE COUNTER
P/O PROCESSOR BOARD
ANALOG TO DIGITAL CONVERTER SUBSYSTEM
PLL ERROR DETECT
SWALLOW COUNTER & CONTROL
REFERENCE FREQUENCY SIGNAL
X16 FREQUENCY MULTIPLIER
PULSE COUNTER
16
OUTPUT BUFFER
8
REFERENCE FREQUENCY CHANNEL


J1
2 4
PINS ON BACK SIDE
50
1 3
49
J2
2 4
PINS ON BACK SIDE
50
1 3
49
05508-60003
TP6
C10
U6
CR1
C27
R17
R18
CR2
C46
R62
TP5
U19
TP18
U26
TP16
TP17
TP22
U20
U27
JMP2
CR3
CR4
C29
R24
R27
R34
R38
JMP3
R39
TP19
MEAS ECL
U21
U28
TP41
R28
U22
U29
TP21
U23
U30
TP13
TP20
U24
U31
TP10
R14
R15
R16
R19
R20
R21
U25
C50
C75

THE COMPLETE COMPONENT LOCATOR
FOR A3 IS SHOWN ON SHEET 5

/21560

COUNTER BOARD (05508-60003

A3J1 PIN	SIGNAL	TO/FF
1	A1	FROM A2J1-1
2	+5V	FROM A5J1-2
3	A0	FROM A2J1-3
4	+5V	FROM A5J1-4
5	NC	
6	+5V	FROM A5J1-6
7	D7	TO/FROM A1J1-7
8	+5V	FROM A5J1-8
9	D6	TO/FROM A1J1-9
10	+5V	FROM A5J1-10
11	D5	TO/FROM A1J1-1
12	+5V	FROM A5J1-12
13	D4	TO/FROM A1J1-1
14	+5V	FROM A5J1-14
15	D3	TO/FROM A1J1-1
16	+5V	FROM A5J1-16
17	D2	TO/FROM A1J1-1
18	+5V	FROM A5J1-18
19	D1	TO/FROM A1J1-1
20	+5V	FROM A5J1-20
21	D0	TO/FROM A1JA-2
22	+15V	FROM A5J1-22
23	$\overline{\text{FE2}}$	FROM A2J1-23
24	-15V	FROM A5J1-24
25	$\overline{\text{FE1}}$	FROM A2J1-25
26	NC	
27	NC	
28	$\overline{\text{IN7}}$	TO A2J1-28
29	NC	
30	GND	FROM A5J1-30
31	NC	
32	GND	FROM A5J1-32
33	$\overline{\text{CBE}}$	FROM A2J1-33
34	GND	FROM A5J1-34
35	$\overline{\text{NMI}}$	TO A2J1-35
36	GND	FROM A5J1-36
37	NC	
38	GND	FROM A5J1-38
39	$\overline{\text{IN4}}$	TO A2J1-39
40	GND	FROM A5J1-40
41	NC	
42	GND	FROM A5J1-42
43	R/$\overline{\text{W}}$	FROM A2J1-43
44	GND	FROM A5J1-44
45	GND	
46	GND	FROM A5J1-46
47	$\overline{\text{E}}$	FROM A2J1-47
48	GND	FROM A5J1-48
49	$\overline{\text{RESET}}$	FROM A2J1-49
50	GND	FROM A5J1-50

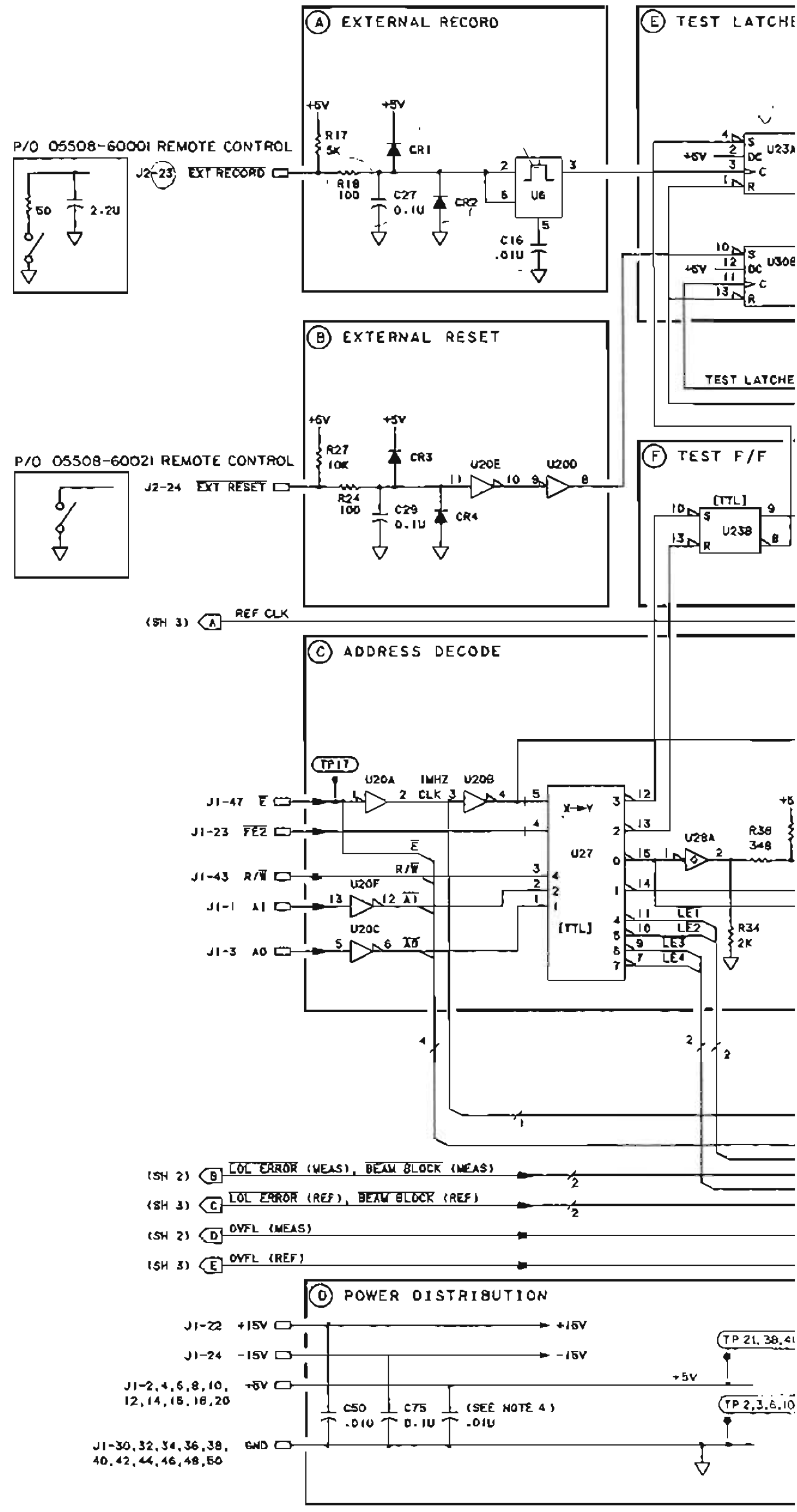
A3J2 PIN	SIGNAL	TO/F
1	GND	FROM A4J1-1 (
2	AP	FROM A4J1-2 (
3	GND	FROM A4J1-
4	ANALOG GND	FROM A4J1-4
5	MT3	FROM A4J1-5
6	AT	FROM A4J1-6
7	MT2	FROM A4J1-7
8	ANALOG GND	FROM A4J1-8
9	MT1	FROM A4J1-9
10	ARH	FROM A4J1-10
11	+10VREF	TO A4J1-11
12	ANALOG GND	FROM A4J1-12
13	GND	FROM A4J1-13
14	$\overline{\text{MEAS}}$	FROM A4J1-14
15	MEAS	FROM A4J1-15
16	GND	FROM A4J1-16
17	REF	FROM A4J1-17
18	$\overline{\text{REF}}$	FROM A4J1-18
19	GND	FROM A4J1-19
20	EM GND	TO A4J1-20
21	NC	
22	NC	
(23)	$\overline{\text{EXT-RECORD}}$	FROM A4J1-23
24	$\overline{\text{EXT-RESET}}$	FROM A4J1-24
(25)	GND	FROM A4J1-25
26	GND	FROM A4J1-26
27	NC	
28	NC	
29	NC	
30	NC	
31	NC	
32	NC	
33	NC	
34	NC	
35	NC	
36	NC	
37	NC	
38	NC	
39	NC	
40	NC	
41	NC	
42	NC	
43	NC	
44	NC	
45	NC	
46	NC	
47	NC	
48	NC	
49	NC	
50	NC	

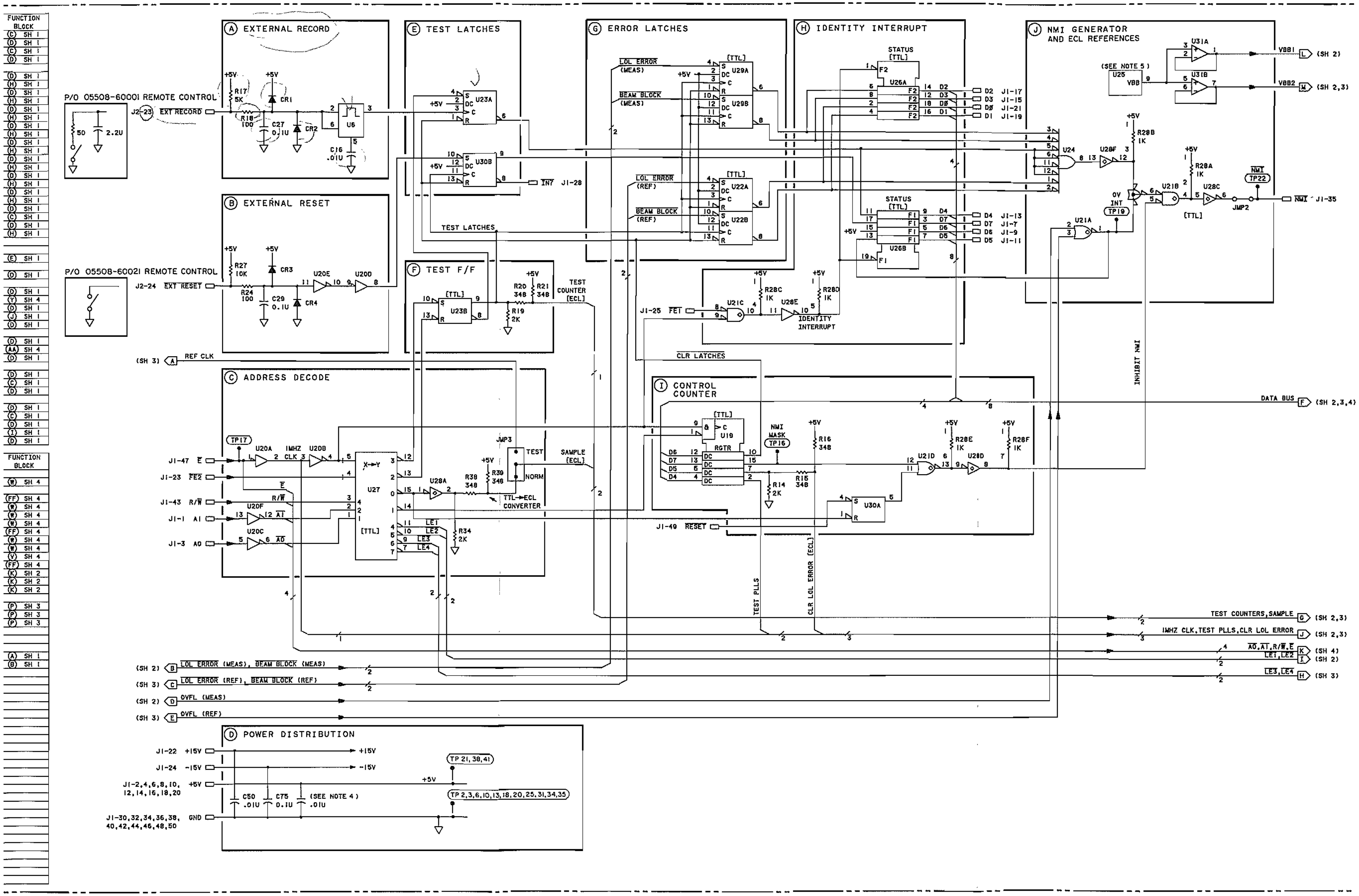
/21560

COUNTER BOARD (05508-60003) SERIES 2516

A3J1 PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	A1	FROM A2J1-1	Ⓒ SH 1
2	+5V	FROM A5J1-2	Ⓓ SH 1
3	A0	FROM A2J1-3	Ⓒ SH 1
4	+5V	FROM A5J1-4	Ⓓ SH 1
5	NC		
6	+5V	FROM A5J1-6	Ⓓ SH 1
7	D7	TO/FROM A1J1-7 & A2J1-7	Ⓗ SH 1
8	+5V	FROM A5J1-8	Ⓓ SH 1
9	D6	TO/FROM A1J1-9 & A2J1-9	Ⓗ SH 1
10	+5V	FROM A5J1-10	Ⓓ SH 1
11	D5	TO/FROM A1J1-11 & A2J1-11	Ⓗ SH 1
12	+5V	FROM A5J1-12	Ⓓ SH 1
13	D4	TO/FROM A1J1-13 & A2J1-13	Ⓗ SH 1
14	+5V	FROM A5J1-14	Ⓓ SH 1
15	D3	TO/FROM A1J1-15 & A2J1-15	Ⓗ SH 1
16	+5V	FROM A5J1-16	Ⓓ SH 1
17	D2	TO/FROM A1J1-17 & A2J1-17	Ⓗ SH 1
18	+5V	FROM A5J1-18	Ⓓ SH 1
19	D1	TO/FROM A1J1-19 & A2J1-19	Ⓗ SH 1
20	+5V	FROM A5J1-20	Ⓓ SH 1
21	D0	TO/FROM A1JA-21 & A2J1-21	Ⓗ SH 1
22	+15V	FROM A5J1-22	Ⓓ SH 1
23	FE2	FROM A2J1-23	Ⓒ SH 1
24	-15V	FROM A5J1-24	Ⓓ SH 1
25	$\overline{\text{FE1}}$	FROM A2J1-25	Ⓗ SH 1
26	NC		
27	NC		
28	IN7	TO A2J1-28	Ⓔ SH 1
29	NC		
30	GND	FROM A5J1-30	Ⓓ SH 1
31	NC		
32	GND	FROM A5J1-32	Ⓓ SH 1
33	$\overline{\text{CBE}}$	FROM A2J1-33	Ⓨ SH 4
34	GND	FROM A5J1-34	Ⓓ SH 1
35	$\overline{\text{NMI}}$	TO A2J1-36	Ⓙ SH 1
36	GND	FROM A5J1-36	Ⓓ SH 1
37	NC		
38	GND	FROM A5J1-38	Ⓓ SH 1
39	$\overline{\text{IN4}}$	TO A2J1-39	(AA) SH 4
40	GND	FROM A5J1-40	Ⓓ SH 1
41	NC		
42	GND	FROM A5J1-42	Ⓓ SH 1
43	R/$\overline{\text{W}}$	FROM A2J1-43	Ⓒ SH 1
44	GND	FROM A5J1-44	Ⓓ SH 1
45	GND		
46	GND	FROM A5J1-46	Ⓓ SH 1
47	E	FROM A2J1-47	Ⓒ SH 1
48	GND	FROM A5J1-48	Ⓓ SH 1
49	$\overline{\text{RESET}}$	FROM A2J1-49	Ⓘ SH 1
50	GND	FROM A5J1-50	Ⓓ SH 1

A3J2 PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	GND	FROM A4J1-1 (NC)	
2	AP	FROM A4J1-2 (NC)	Ⓦ SH 4
3	GND	FROM A4J1-	
4	ANALOG GND	FROM A4J1-4	(FF) SH 4
5	MT3	FROM A4J1-5	Ⓦ SH 4
6	AT	FROM A4J1-6	Ⓦ SH 4
7	MT2	FROM A4J1-7	Ⓦ SH 4
8	ANALOG GND	FROM A4J1-8	(FF) SH 4
9	MT1	FROM A4J1-9	Ⓦ SH 4
10	ARH	FROM A4J1-10	Ⓦ SH 4
11	+10VREF	TO A4J1-11	Ⓥ SH 4
12	ANALOG GND	FROM A4J1-12	(FF) SH 4
13	GND	FROM A4J1-13	Ⓚ SH 2
14	$\overline{\text{MEAS}}$	FROM A4J1-14	Ⓚ SH 2
15	MEAS	FROM A4J1-15	Ⓚ SH 2
16	GND	FROM A4J1-16	
17	REF	FROM A4J1-17	Ⓟ SH 3
18	$\overline{\text{REF}}$	FROM A4J1-18	Ⓟ SH 3
19	GND	FROM A4J1-19	Ⓟ SH 3
20	EM GND	TO A4J1-20	
21	NC		
22	NC		
23	EXT-RECORD	FROM A4J1-23	Ⓐ SH 1
24	EXT-$\overline{\text{RESET}}$	FROM A4J1-24	Ⓑ SH 1
25	GND	FROM A4J1-25	
26	GND	FROM A4J1-26	
27	NC		
28	NC		
29	NC		
30	NC		
31	NC		
32	NC		
33	NC		
34	NC		
35	NC		
36	NC		
37	NC		
38	NC		
39	NC		
40	NC		
41	NC		
42	NC		
43	NC		
44	NC		
45	NC		
46	NC		
47	NC		
48	NC		
49	NC		
50	NC		


Ⓐ EXTERNAL RECORD
Ⓔ TEST LATCHE
P/O 05508-60001 REMOTE CONTROL
J2-23 EXT RECORD
+5V
R17 5K
CR1
R18 100
C27 0.1U
CR2
U6
C16 .01U
50
2.2U
U23A
U30B
TEST LATCHE
Ⓑ EXTERNAL RESET
P/O 05508-60021 REMOTE CONTROL
J2-24 EXT RESET
R27 10K
CR3
R24 100
C29 0.1U
CR4
U20E
U20D
Ⓕ TEST F/F
U23B
(TTL)
(SH 3) Ⓐ REF CLK
Ⓒ ADDRESS DECODE
TP17
U20A
1MHZ CLK
U20B
J1-47 E
J1-23 FE2
J1-43 R/W
J1-1 A1
J1-3 A0
U20F
U20C
U27
X→Y
(TTL)
U28A
R38 348
R34 2K
LE1
LE2
LE3
LE4
(SH 2) Ⓑ LOL ERROR (MEAS), BEAM BLOCK (MEAS)
(SH 3) Ⓒ LOL ERROR (REF), BEAM BLOCK (REF)
(SH 2) Ⓓ OVFL (MEAS)
(SH 3) Ⓔ OVFL (REF)
Ⓓ POWER DISTRIBUTION
J1-22 +15V
J1-24 -15V
J1-2,4,6,8,10,12,14,16,18,20 +5V
J1-30,32,34,36,38,40,42,44,46,48,50 GND
C50 .01U
C75 0.1U
(SEE NOTE 4) .01U
TP 21,38,4
TP 2,3,6,10


FUNCTION BLOCK
(A) EXTERNAL RECORD
(B) EXTERNAL RESET
(C) ADDRESS DECODE
(D) POWER DISTRIBUTION
(E) TEST LATCHES
(F) TEST F/F
(G) ERROR LATCHES
(H) IDENTITY INTERRUPT
(I) CONTROL COUNTER
(J) NMI GENERATOR AND ECL REFERENCES
P/O 05508-60001 REMOTE CONTROL
P/O 05508-60021 REMOTE CONTROL
J2-23 EXT RECORD
J2-24 EXT RESET
REF CLK
TEST LATCHES
CLR LATCHES
INHIBIT NMI
DATA BUS
TEST COUNTERS, SAMPLE
1MHZ CLK, TEST PLLS, CLR LOL ERROR
A0, A1, R/W, E
LE1, LE2
LE3, LE4
LOL ERROR (MEAS), BEAM BLOCK (MEAS)
LOL ERROR (REF), BEAM BLOCK (REF)
OVFL (MEAS)
OVFL (REF)
VBB1
VBB2
NMI J1-35
INT J1-28
J1-25 FET
J1-49 RESET
J1-47 E
J1-23 FE2
J1-43 R/W
J1-1 A1
J1-3 A0
J1-22 +15V
J1-24 -15V
J1-2,4,6,8,10,12,14,16,18,20 +5V
J1-30,32,34,36,38,40,42,44,46,48,50 GND
TP 21,38,41
TP 2,3,6,10,13,18,20,25,31,34,35
(SEE NOTE 4)
TTL→ECL CONVERTER
TEST
NORM
SAMPLE (ECL)
TEST COUNTER (ECL)
NMI MASK
IDENTITY INTERRUPT
TEST PLLS
CLR LOL ERROR (ECL)
STATUS [TTL]

NOTES:

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.

2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN FARADS;
   INDUCTANCE IN HENRIES

3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.

4. THE FOLLOWING .01µF CAPACITORS ARE USED FOR BYPASSING THE +5V LINE: C5-9, 11-13, 15, 17-19, 22-26, 28, 30-38, 40-42, 49, 51, 52, 54, 56, 57, 59, 62, 63, 65-67, 69, AND C77.

5. VBB, VBB1, VBB2 ARE ≈ 1.29V LESS THAN THE ACTUAL VALUE OF THE +5V SUPPLY

6. POWER, GROUND CONNECTIONS FOR IC'S, UNLESS INDICATED ON SCHEMATIC, ARE AS FOLLOWS:
   A) U6: PIN 8 TO +5V; PIN 1 TO GROUND
   B) U12, U44: PINS 7, 20 TO +5V; PINS 10, 16 TO GROUND
   C) U31: PIN 8 TO +15V; PIN 4 TO GROUND
   D) OTHER TTL: HIGHEST NUMBERED PIN TO +5V; DIAGONALLY OPPOSITE PIN TO GROUND
   E) OTHER ECL: HIGHEST NUMBERED PIN & PIN 1 TO +5V; PIN OPPOSITE HIGHEST NUMBERED TO GROUND

7. THE FOLLOWING NON-SIGNAL CONNECTIONS EXIST BUT ARE NOT SHOWN ON THE SCHEMATIC:
   A) TO +5V: U6-4, U14-4, 12; U23-11, 12, U27-6; U30-3; U32-2, 3, 10, 11; U34-4, 12; U35-4, 12
   B) OTHER: U25-9 TO U25-11, 12

Reference Designations
C1-79
CR1-5, 7-18
DS1, 2
J1-5
JMP1-5
R1-18, 20-56, 60-62
S1, 2
TP40
U1-67

Deleted: CR6, R19, R57, R58, R59

Figure 8-B-21. 5508A A3 Counter Board 05508-60003, Counter Control Circuits (Sheet 1 of 5)

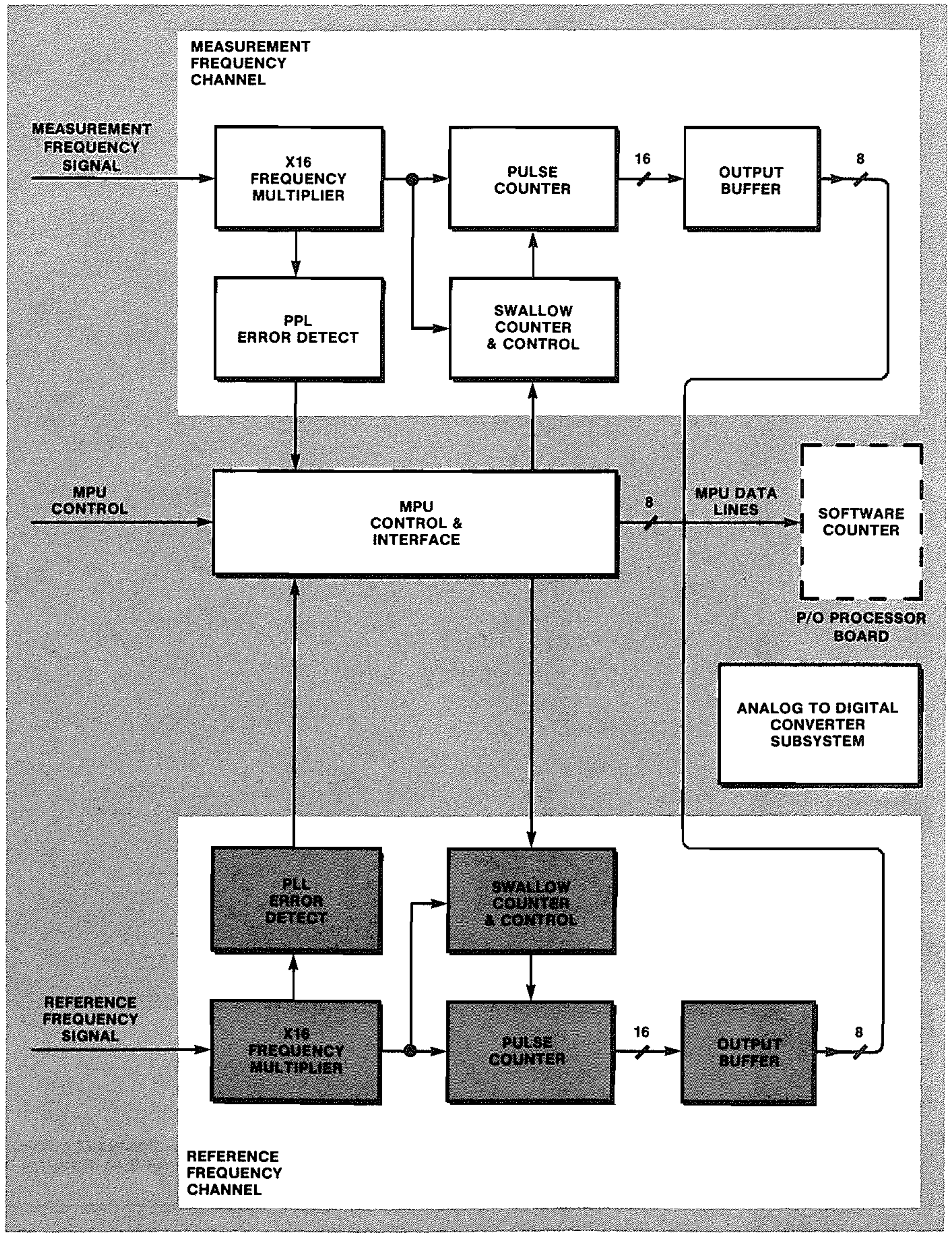
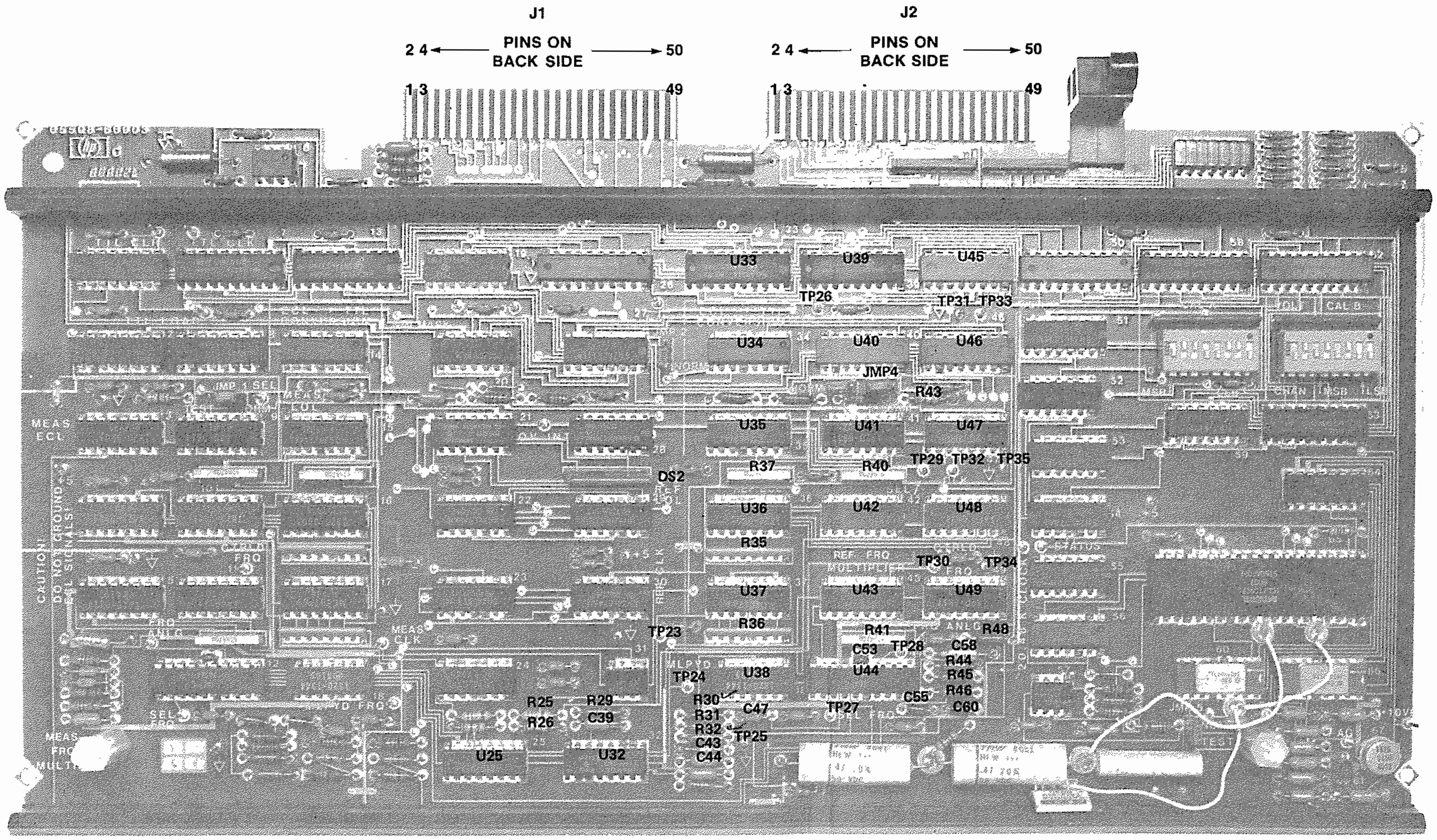

MEASUREMENT FREQUENCY CHANNEL
MEASUREMENT FREQUENCY SIGNAL
X16 FREQUENCY MULTIPLIER
PULSE COUNTER
16
OUTPUT BUFFER
8
PPL ERROR DETECT
SWALLOW COUNTER & CONTROL
MPU CONTROL
MPU CONTROL & INTERFACE
8
MPU DATA LINES
SOFTWARE COUNTER
P/O PROCESSOR BOARD
ANALOG TO DIGITAL CONVERTER SUBSYSTEM
PLL ERROR DETECT
SWALLOW COUNTER & CONTROL
REFERENCE FREQUENCY SIGNAL
X16 FREQUENCY MULTIPLIER
PULSE COUNTER
16
OUTPUT BUFFER
8
REFERENCE FREQUENCY CHANNEL

Figure 8-B-21
5508A A3 COUNTER BOARD 05508-60003, COUNTER CONTROL CIRCUITS (Sheet 1 of 5)

(See Page 8-B-71)


J1
2 4
PINS ON BACK SIDE
50
1 3
49
J2
2 4
PINS ON BACK SIDE
50
1 3
49
U33
U39
U45
TP26
TP31
TP33
U34
U40
U46
JMP4
R43
U35
U41
U47
R37
R40
TP29
TP32
TP35
DS2
U36
U42
U48
R35
TP30
TP34
U37
U43
U49
R36
R41
R48
TP23
TP28
C53
C58
R44
TP24
U38
U44
R45
R46
R25
R29
R30
C55
C60
R26
C39
R31
C47
TP27
R32
C43
TP25
U25
U32
C44
MEAS ECL
CAUTION DO NOT GROUND ECL SIGNALS
REF FRQ MULTIPLIER
STATUS
TEST

THE COMPLETE COMPONENT LOCATOR
FOR A3 IS SHOWN ON SHEET 5

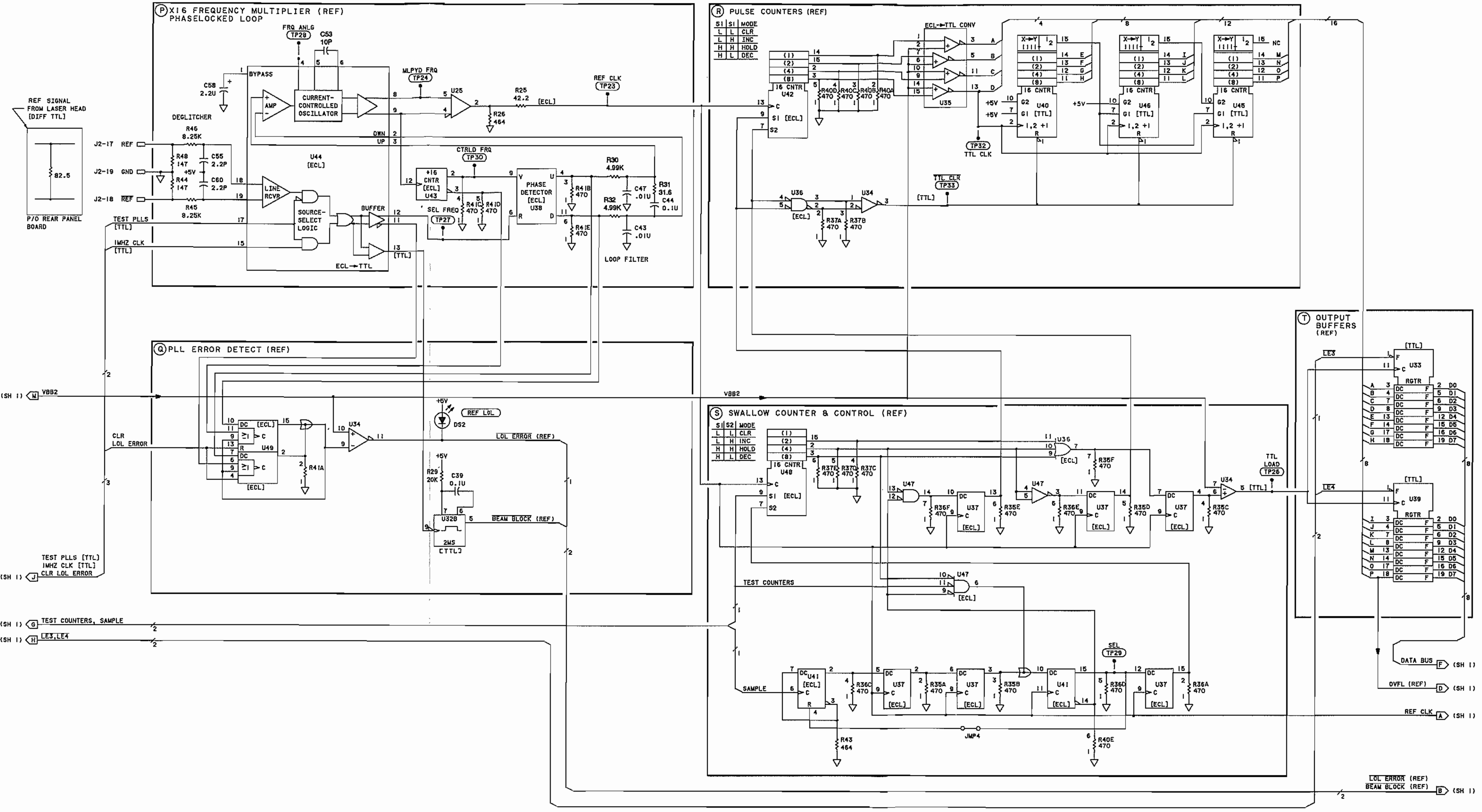
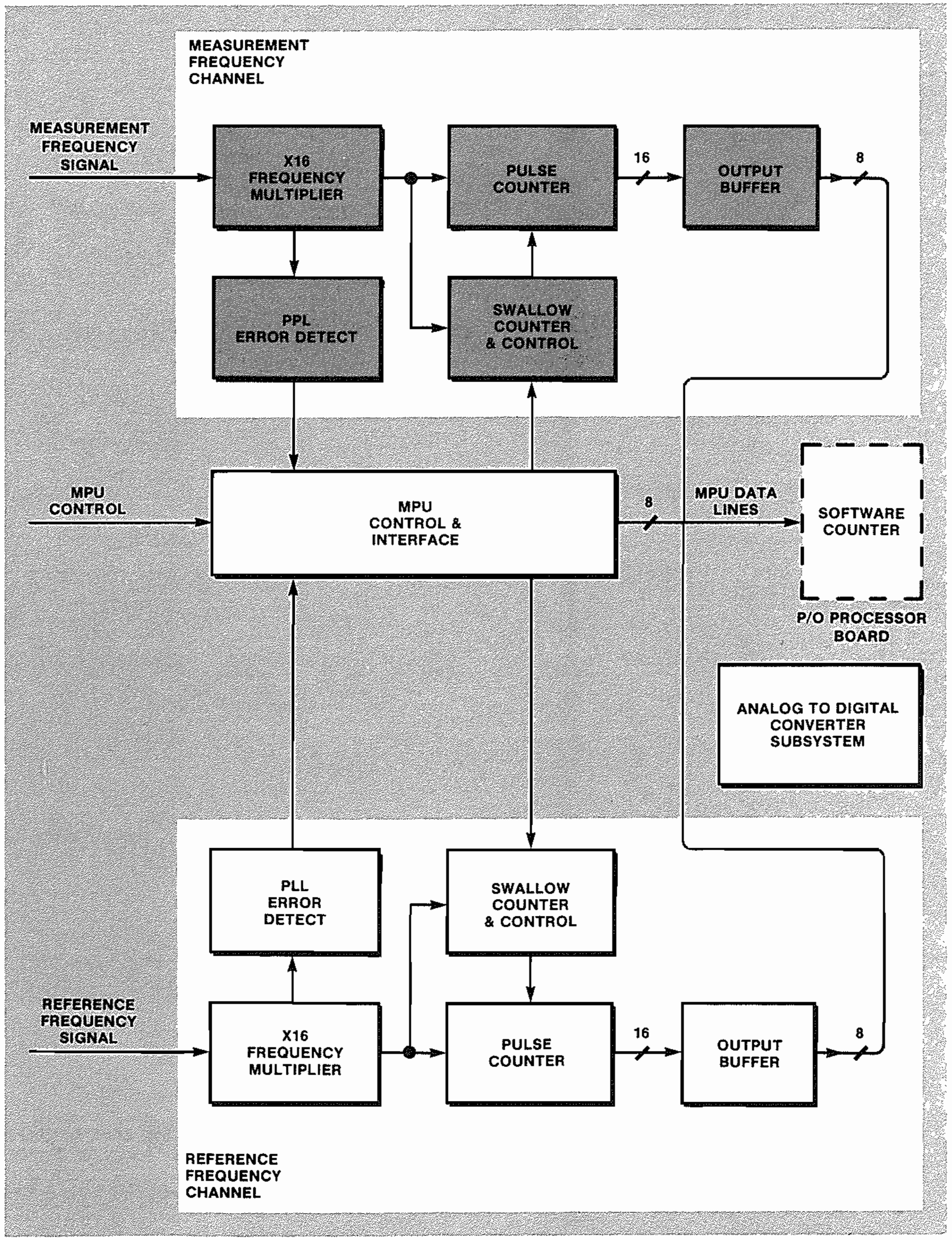
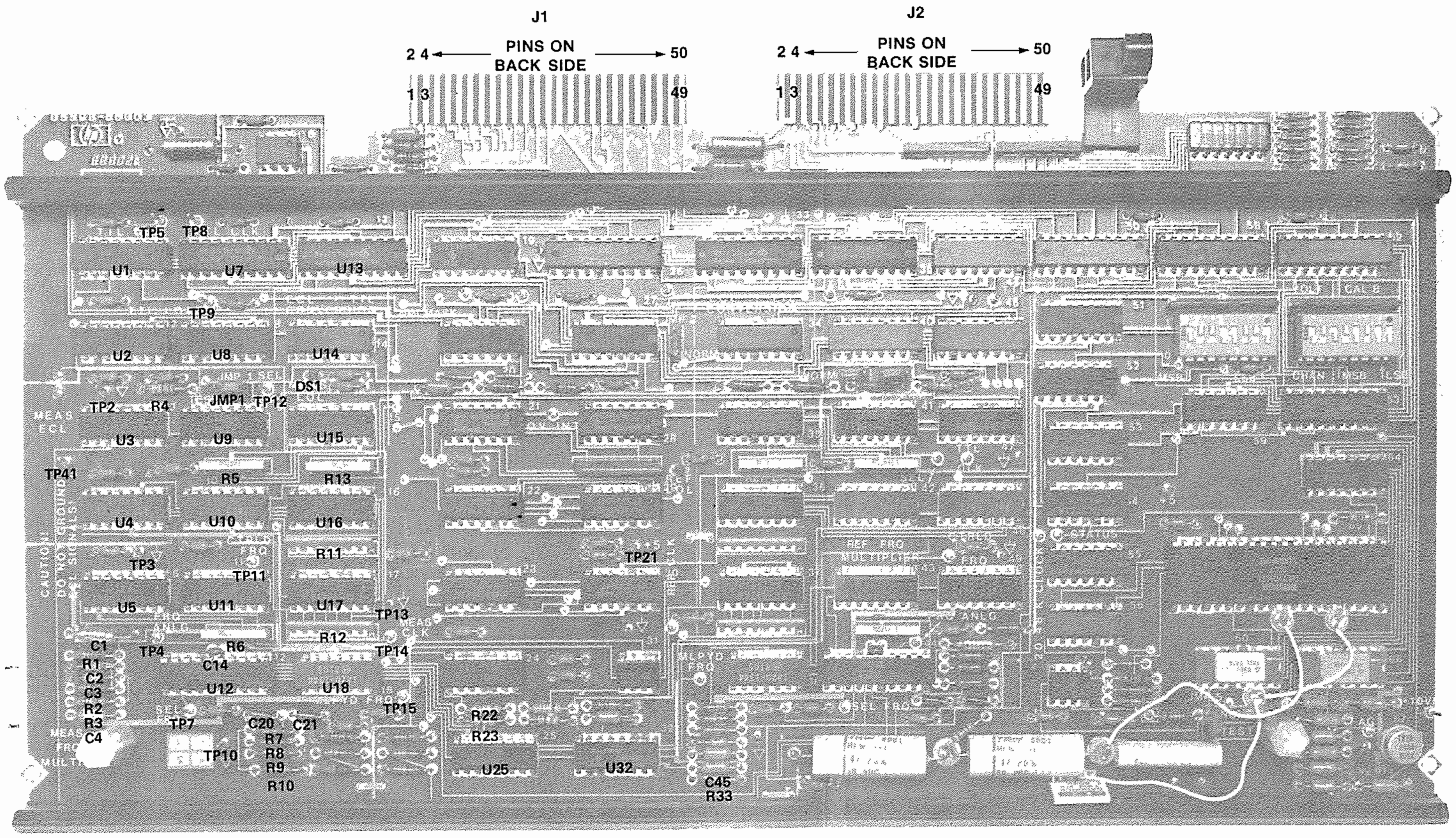

P X16 FREQUENCY MULTIPLIER (REF) PHASELOCKED LOOP
FRQ ANLG TP28
C53 10P
C58 2.2U
BYPASS
AMP
CURRENT-CONTROLLED OSCILLATOR
MLPYD FRQ TP24
U25
R25 42.2
[ECL]
REF CLK TP23
R26 464
REF SIGNAL FROM LASER HEAD (DIFF TTL)
82.5
P/O REAR PANEL BOARD
J2-17 REF
J2-19 GND
J2-18 REF
DEGLITCHER
R46 8.25K
R48 147
R44 147
+5V
C55 2.2P
C60 2.2P
R45 8.25K
DWN
UP
U44 [ECL]
CTRLD FRQ TP30
÷16 CNTR [ECL] U43
SEL FREQ TP27
R41C 470
R41D 470
PHASE DETECTOR [ECL] U38
R41B 470
R41E 470
R30 4.99K
R31 31.6
C47 .01U
C44 0.1U
R32 4.99K
C43 .01U
LOOP FILTER
LINE RCVR
SOURCE-SELECT LOGIC
BUFFER
ECL→TTL
[TTL]
TEST PLLS [TTL]
1MHZ CLK [TTL]
R PULSE COUNTERS (REF)
S1 S1 MODE
L L CLR
L H INC
H H HOLD
H L DEC
16 CNTR U42
S1 [ECL]
S2
R40D 470
R40C 470
R40B 470
R40A 470
ECL→TTL CONV
U35
TP32 TTL CLK
+5V
X→Y
16 CNTR
G2 U40
G1 [TTL]
1,2 +1
G2 U46
G1 [TTL]
G2 U45
G1 [TTL]
NC
A B C D E F G H I J K L M N O P
U36
U34
TTL CLR TP33
[TTL]
R37A 470
R37B 470
Q PLL ERROR DETECT (REF)
(SH 1) M VBB2
VBB2
CLR LOL ERROR
DC [ECL]
≥1
U49
[ECL]
R41A
U34
+5V
REF LOL
DS2
LOL ERROR (REF)
+5V
R29 20K
C39 0.1U
U32B
2MS [TTL]
BEAM BLOCK (REF)
TEST PLLS [TTL]
1MHZ CLK [TTL]
CLR LOL ERROR
(SH 1) J
(SH 1) G TEST COUNTERS, SAMPLE
(SH 1) H LE3,LE4
S SWALLOW COUNTER & CONTROL (REF)
S1 S2 MODE
L L CLR
L H INC
H H HOLD
H L DEC
16 CNTR U48
S1 [ECL]
S2
R37E 470
R37D 470
R37C 470
U36
R36F 470
U47
R36F 470
U37 [ECL]
R35E 470
U47
R36E 470
U37 [ECL]
R35D 470
U37 [ECL]
R35C 470
U34
TTL LOAD TP26
[TTL]
TEST COUNTERS
U47 [ECL]
SAMPLE
U41 [ECL]
R36C 470
U37 [ECL]
R35A 470
U37 [ECL]
R35B 470
U41 [ECL]
R36D 470
U37 [ECL]
R36A 470
SEL TP29
R43 464
JMP4
R40E 470
T OUTPUT BUFFERS (REF)
LE3
[TTL]
U33
RGTR
D0 D1 D2 D3 D4 D5 D6 D7
LE4
U39
DATA BUS F (SH 1)
OVFL (REF) D (SH 1)
REF CLK A (SH 1)
LOL ERROR (REF)
BEAM BLOCK (REF) B (SH 1)

Figure 8-B-21. 5508A A3 Counter Board 05508-60003, Reference Frequency Channel (Sheet 2 of 5)

Figure 8-B-21
5508A A3 COUNTER BOARD 05508-60003,
REFERENCE FREQUENCY CHANNEL (Sheet 2 of 5)

(See Page 8-B-73)


MEASUREMENT FREQUENCY CHANNEL
MEASUREMENT FREQUENCY SIGNAL
X16 FREQUENCY MULTIPLIER
PULSE COUNTER
16
OUTPUT BUFFER
8
PPL ERROR DETECT
SWALLOW COUNTER & CONTROL
MPU CONTROL
MPU CONTROL & INTERFACE
8
MPU DATA LINES
SOFTWARE COUNTER
P/O PROCESSOR BOARD
ANALOG TO DIGITAL CONVERTER SUBSYSTEM
PLL ERROR DETECT
SWALLOW COUNTER & CONTROL
REFERENCE FREQUENCY SIGNAL
X16 FREQUENCY MULTIPLIER
PULSE COUNTER
16
OUTPUT BUFFER
8
REFERENCE FREQUENCY CHANNEL


J1
2 4
PINS ON BACK SIDE
50
1 3
49
J2
2 4
PINS ON BACK SIDE
50
1 3
49
TP5
TP8
U1
U7
U13
TP9
U2
U8
U14
DS1
TP2
R4
JMP1
TP12
MEAS ECL
U3
U9
U15
TP41
R5
R13
U4
U10
U16
R11
TP3
TP11
U5
U11
U17
TP13
C1
TP4
R6
R12
TP14
R1
C14
C2
C3
U12
U18
R2
TP15
R3
TP7
C20
C21
R22
C4
R7
R23
TP10
R8
U25
U32
R9
R10
TP21
C45
R33
CAUTION! DO NOT GROUND ECL SIGNALS!

THE COMPLETE COMPONENT LOCATOR
FOR A3 IS SHOWN ON SHEET 5

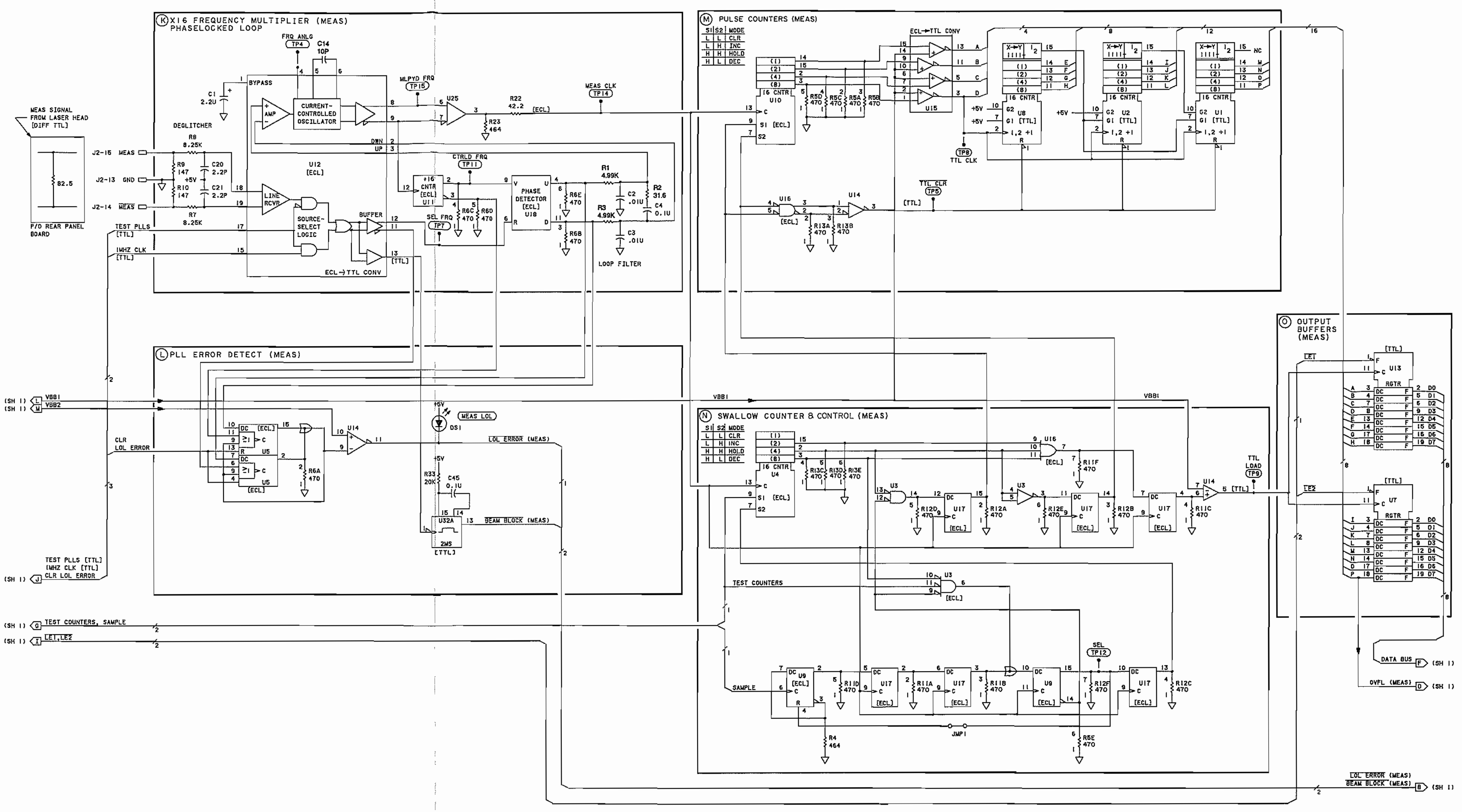

K X16 FREQUENCY MULTIPLIER (MEAS) PHASELOCKED LOOP
FRQ ANLG TP4
C14 10P
BYPASS
C1 2.2U
AMP
CURRENT-CONTROLLED OSCILLATOR
MLPYD FRQ TP15
U25
R22 42.2
[ECL]
MEAS CLK TP14
R23 464
MEAS SIGNAL FROM LASER HEAD (DIFF TTL)
82.5
P/O REAR PANEL BOARD
DEGLITCHER
R8 8.25K
R9 147
R10 147
R7 8.25K
C20 2.2P
C21 2.2P
+5V
J2-15 MEAS
J2-13 GND
J2-14 MEAS
U12 [ECL]
LINE RCVR
SOURCE-SELECT LOGIC
BUFFER
DWN
UP
CTRLD FRQ TP11
÷16 CNTR [ECL] U11
SEL FRQ TP7
R6C 470
R6D 470
PHASE DETECTOR [ECL] U18
R6E 470
R6B 470
R1 4.99K
R3 4.99K
R2 31.6
C2 .01U
C4 0.1U
C3 .01U
LOOP FILTER
ECL→TTL CONV
[TTL]
TEST PLLS [TTL]
1MHZ CLK [TTL]
L PLL ERROR DETECT (MEAS)
(SH 1) L VBB1
(SH 1) M VBB2
CLR LOL ERROR
[ECL]
U5
R6A 470
U14
+5V
MEAS LOL
DS1
LOL ERROR (MEAS)
R33 20K
C45 0.1U
U32A
2MS
[TTL]
BEAM BLOCK (MEAS)
TEST PLLS [TTL]
1MHZ CLK [TTL]
(SH 1) J CLR LOL ERROR
(SH 1) G TEST COUNTERS, SAMPLE
(SH 1) I LE1,LE2
M PULSE COUNTERS (MEAS)
S1 S2 MODE
L L CLR
L H INC
H H HOLD
H L DEC
16 CNTR U10
S1 [ECL]
S2
R5D 470
R5C 470
R5A 470
R5B 470
ECL→TTL CONV
U15
+5V
TP8 TTL CLK
X→Y
16 CNTR
G2 U8
G1 [TTL]
1,2 +1
G2 U2
G1 [TTL]
G2 U1
G1 [TTL]
NC
U16
[ECL]
R13A 470
R13B 470
U14
[TTL]
TTL CLR TP5
VBB1
N SWALLOW COUNTER & CONTROL (MEAS)
16 CNTR U4
S1 [ECL]
R13C 470
R13D 470
R13E 470
U16
R11F 470
U3
R12D 470
U17
R12A 470
R12E 470
R12B 470
R11C 470
TTL LOAD TP9
TEST COUNTERS
U3
[ECL]
SAMPLE
U9 [ECL]
R11D 470
R11A 470
R11B 470
SEL TP12
R12F 470
R12C 470
R4 464
JMP1
R5E 470
O OUTPUT BUFFERS (MEAS)
LE1
LE2
[TTL]
U13
RGTR
U7
D0 D1 D2 D3 D4 D5 D6 D7
DATA BUS F (SH 1)
OVFL (MEAS) D (SH 1)
LOL ERROR (MEAS)
BEAM BLOCK (MEAS) B (SH 1)

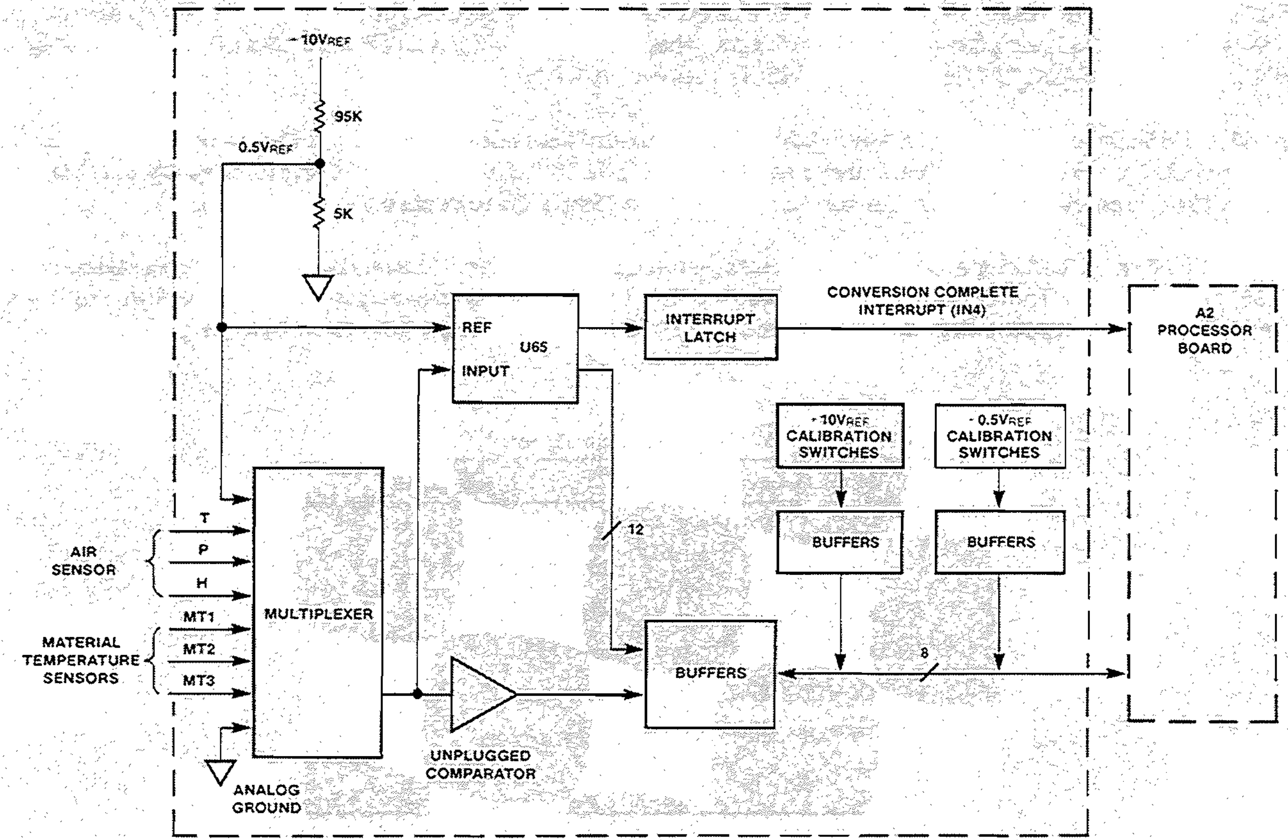
Figure 8-B-21. 5508A A3 Counter Board 05508-60003, Measurement Frequency Channel (Sheet 3 of 5)

Figure 8-B-21
5508A A3 COUNTER BOARD 05508-60003, MEASUREMENT FREQUENCY CHANNEL (Sheet 3 of 5)

(See Page 8-B-75)

8-B-228. 5508A A3 ANALOG SUBSYSTEM BLOCK DIAGRAM DESCRIPTION

8-B-229. The Analog Subsystem uses a 12 bit, analog-to-digital converter, A3U65, and an eight-channel multiplexer to convert sensor voltages to digital signals for use by the Processor. Three of the multiplexer channels are for the Air Sensor; three are allotted for up to three Material Temperature Sensors; and the remaining two channels are used for power-up self-test. The Analog Subsystem Block Diagram is shown below.


-10VREF
95K
0.5VREF
5K
REF
U65
INPUT
INTERRUPT LATCH
CONVERSION COMPLETE INTERRUPT (IN4)
A2 PROCESSOR BOARD
-10VREF CALIBRATION SWITCHES
- 0.5VREF CALIBRATION SWITCHES
BUFFERS
BUFFERS
12
8
BUFFERS
AIR SENSOR
T
P
H
MATERIAL TEMPERATURE SENSORS
MT1
MT2
MT3
MULTIPLEXER
UNPLUGGED COMPARATOR
ANALOG GROUND

8-B-230. 5508A A3 ANALOG SUBSYSTEM CIRCUIT THEORY

8-B-231. Paragraphs 8-B-232 through 8-B-266 contain circuit theory for the Analog Subsystem on A3. Paragraphs 8-B-267 through 8-B-326 cover the troubleshooting information.

8-B-232. The schematic diagram for the Analog Subsystem is shown in Figure 8-B-21 sheet 4. The schematic has functional blocks that are labeled alphabetically with circled letters. These labels correspond to the circled letters in the text for the circuit theory.

8-B-233. Analog-To-Digital Converter (FF)

8-B-234. A to D converter U65 is a CMOS integrated circuit with an input range of ±1 V. Power supply requirements for U65 are plus and minus 5 Volts where the plus 5 Volts is filtered from the logic supply by A3R62, A3C46 and A3C79. The minus 5 Volts is derived by U61.

8-B-235. U65 also requires a precision +0.5 Volt reference. This is obtained from voltage divider R50 which is driven by U67, a precision 10 Volt source, see Block U. The 10 V reference (10 Vref) is used by the Material Temperature Sensors and the Air Sensor as an offset for temperature measurement signals.

8-B-236. U65 is a quad slope, or auto-zero, analog-to-digital converter. It has a fixed-length integration period of 100 milliseconds. The converter is ratiometric, i.e., the digital output is proportional to Vin/+0.5 Vref. Following are some representative outputs (note that the most significant bit (13) indicates polarity):

Table 8-B-4. A to D Converter Example Outputs

Digital Output	Analog Input
1 111 111 111 111	Vin = 2 × Vref where Vref is 0.5 Vref
1 100 000 000 000	Vin = Vref
1 000 000 000 000	Vin = +0
0 000 000 000 000	Vin = -0
0 100 000 000 000	Vin = -Vref
0 111 111 111 111	Vin = - 2 × Vref

8-B-237. Voltage Reference Ⓤ and Digital Calibration Switches (DD)

8-B-238. +10 Vref is digitally calibrated and provides the most accurate voltage reference in the 5528A system. Digital calibration eliminates the error factors that are normally associated with potentiometer adjustments such as thermal coefficient and long term drift.

8-B-239. During calibration, a binary number representing the true value of +10 Vref is set into switch CAL A. The true value can be ±10.24 mV from 10.0000 Volts without exceeding the calibration range of the CAL A switches. The CAL A switches A3S1, are described in Paragraph 8-B-27. Inaccurate calibration of +10 Vref or failure of the CAL A switch circuitry results in an offset error in temperature measurements. Note that pressure measurements do not use +10 Vref and consequently are not affected by inaccuracies of this supply.

8-B-240. The setting of the CAL A switch establishes a correction factor for the temperature measurements and corresponding corrections are made in the 5508A software. The correction factor is computed and stored at 5508A power-up or when the MASTER RESET switch A2S2 is pressed. These are the only times that CAL A is read. The settings of CAL A should not be changed except during calibration or troubleshooting.

8-B-241. +0.5 Vref is derived from +10 Vref by R50. Digital calibration for +0.5 Vref is implemented by five bits of CAL B switch A3S2. See Figure 8-B-21 sheet 4. To obtain the required A to D conversion accuracy, the MPU multiplies the ratiometric output of the A to D by a correction factor determined from the CAL B settings. The use of CAL A for +10 Vref is somewhat different. +10 Vref is used as an offset, therefore the correction factor derived from the settings of CAL A is an additive correction factor. CAL B is read only at 5508A power-up or after a hardware reset. Inaccurate calibration of CAL B or failure of the CAL B switch circuitry will affect all sensor measurement signals because the A to D output will not be corrected to the true value of +0.5 Vref.

8-B-242. Analog Input Circuits ⓦ

8-B-243. The resistor networks R42 and R49 pulls any unplugged input channel to +2.5 V (normal range is ±1 V) such that an unplugged status can be detected by comparator U57 (Block EE). If a channel is unplugged, the A-to-D Converter skips that channel.

8-B-244. Diodes CR7-CR18 limit the inputs to ±5.6 volts, and series resistor network R56 limits the current through the diodes. The capacitors limit the rise time of input spikes while the protection diodes are turned on by decreasing dV/dt in the range of $+5.6 > \text{Vin} > -5.6$. The capacitors also provide low-pass filtering of the inputs at a frequency compatible with the system frequency response and throughput rate. The protect diodes are mainly to protect the analog switches and to prevent the inputs from exceeding the A to D Converter's ±5 volt non-destructive input range.

8-B-245. Channel Multiplexer (cc)

8-B-246. The channel select latch U63 latches in an 8-bit word from the MPU, where each bit represents a multiplexer channel. U63 is enabled by the bus address decoder, signal U. The truth table is as follows:

Table 8-B-5. Channel Multiplexer Truth Table

D7	D6	D5	D4	D3	D2	D1	D0	Input Channel
0	0	0	0	0	0	0	1	Analog GND = Self Test Input
0	0	0	0	0	0	1	0	Air Pressure
0	0	0	0	0	1	0	0	Air Temperature
0	0	0	0	1	0	0	0	Air Relative Humidity
0	0	0	1	0	0	0	0	Material Temperature 1
0	0	1	0	0	0	0	0	Material Temperature 2
0	1	0	0	0	0	0	0	Material Temperature 3
1	0	0	0	0	0	0	0	+0.5 Vref = Self Test Input

8-B-247. Analog Switches (cc)

8-B-248. The channel select latch controls two quad-analog switches U60 and U66 which implement the multiplexing necessary for the 8-analog channels.

8-B-249. Analog Channel Scanning (Test Chip) ⓩ

8-B-250. When the 5508A is performing a measurement, the MPU sequentially enables each of the six measurement channels and analog ground repetitively. If a channel has no input connected ($\overline{\text{UPL}}$=0V), it will be enabled for approximately 125 usecs. The conversion cycle is not initiated when the MPU recognizes $\overline{\text{UPL}}$. A channel with an input will be enabled for 100 ms or more depending on the magnitude of the input voltage.

8-B-251. The channel scan sequence can be observed by installing an HP 548A logic clip to test chip U64. For example, with only the Air Probe plugged in, the scan pattern would be CH0 - CH1 - CH0 - CH2 - CH0 - CH3 REPEAT. The processor enables analog ground between each of the measurement channel enables in order to remove residual charge from A3C48 at U65-32. Although all other measurement channels are also being enabled, they are enabled for only 125 usec and cannot be observed. Unplugged channel enables within the above sequence can be observed using an HP 545A logic probe. During normal operation pins 10, 11, 14, 15, and 16 should always be high and pins 12 and 13 are low once per A to D conversion cycle.

8-B-252. Unplugged State Comparator (EE)

8-B-253. The "unplugged" comparator, U57, signals the microprocessor whenever a selected analog channel has no sensor attached. Detection of unplugged sensors is performed by an extra read of the A to D high order byte immediately after a multiplexer channel is selected, and before the A to D is enabled to convert that channel. If $\overline{\text{UPL}}$ = 0 (channel unplugged), the processor skips that channel and goes to the next channel. When the microprocessor reads the high order byte (B9 - POL) of the A to D, the $\overline{\text{HBEN}}$ input on the A to D is pulled low. With $\overline{\text{HBEN}}$ low, U57 is enabled and $\overline{\text{UPL}}$ goes true if the input channel voltage exceeds 1.5 Volts.

8-B-254. The output of U57 is wired-OR with B7 of the A to D output. With $\overline{\text{HBEN}}$ low, U65 bit 7 is in a high impedance state and the comparator output will be gated by U50 when signal Q enables the high order byte of the A to D onto the data bus.

8-B-255. Power-Up Self-Test Provisions

8-B-256. Two of the unused channels on the multiplexer connect to +.5 Vref and analog ground. These channels are converted as part of the 5508A power-up self-test. Note that the other six analog inputs are not checked during this test. Sucessful reads of +0.5 Vref and analog ground imply that the channel address, control latches, and interrupt hardware are operating, and that the bus address decoder and A to D bus drivers are operating.

8-B-257. The self-test will fail if hardware failures have occurred, or if excessive noise exists on +0.5 Vref or analog ground. These conditions cause a "FAIL 4" display. Since the self-test cannot detect incorrect settings on the digital calibration switches, the switch settings are displayed during the power-up sequence to allow comparison with the settings on the calibration sticker. See power-up test sequence in Paragraph 3-28.

8-B-258. System Clock and Bus Address Decoder Ⓧ Ⓨ

8-B-259. Although all six low order bits (D0 through D5) of the data bus are connected to control register U59, only bits D2 and D3 are used. The control register is enabled by address signal V of the bus address decoder U51 and is clocked by the MPU system clock, $\overline{\text{E}}$.

8-B-260. Bit D2 connects to the run/hold input of the A to D (U65-26) via the bit C output of U59. Run/hold is held low by the microprocessor to inhibit a new conversion cycle during an A to D output read operation. This is necessary because each new A to D conversion destroys the result of the previous conversion stored in internal output latches.

8-B-261. In Block X, bit D3 becomes line D at the output of U59-10 and enables and disables an interrupt signal to the MPU by controlling the output of AND gate U53C in Block AA. After the A to D updates its output latches, the A to D status line (U65-2) goes low indicating a completed conversion. The status line serves as the clock signal to the interrupt latch U54B in Block AA. With D3 high, the interrupt latch causes a low on $\overline{\text{IN4}}$ whenever the status line goes low. In normal operation, the MPU disables this interrupt by pulling D3 low until it is ready to complete the interrupt service by clearing the interrupt latch and reading the A to D output. Examples of control register outputs are as follows:

Table 8-B-6. Control Register Example Outputs

A	(D0)	B	(D1)	C	(D2)	D	(D3)	E	(D4)	F	(D5)	Comments
	1		1		1		x		1		1	Run
	1		1		0		x		1		1	Hold
	1		1		x		1		1		1	Enable $\overline{\text{IN4}}$
	1		1		x		0		1		1	Disable $\overline{\text{IN4}}$

8-B-262. There are two other considerations concerning the addressing of the A to D Converter. First, because the A to D has a maximum output set-up time that is longer than the read window of the processor, the A to D output enables must be set one processor instruction cycle (minimum) before the processor tries to read the A to D outputs. This is accomplished by two special address signals S and R of the bus address decoder U51, which set FFs U56B or A, respectively (Block X). The FF's inverted outputs are $\overline{\text{LBEN}}$ and $\overline{\text{HBEN}}$, the A to D mnemonics for Low and High byte enables. The signal Q from U51-10 (Block Y) enables U50 (Block FF) to gate the A to D outputs to the bus. Note that the rising edge of Q clears $\overline{\text{LBEN}}$ (U56B) or $\overline{\text{HBEN}}$ (U56A) and that they cross-clear such that both cannot be enabled at the same time. Note also that aside from timing considerations, U50 is necessary for bus drive purposes, because U65 doesn't have the fanout necessary to drive the processor bus.

8-B-263. The second consideration is the difference between disabling and clearing the interrupt $\overline{\text{IN4}}$. Clearing of the interrupt is accomplished by signal T which connects from U51-13 (Block Y) to U54-10 (Block AA). This destroys previous data and is used only during the interrupt service routine when data is read from the A to D. Disabling the interrupt, via U59-10 bit D, permits the processor to temporarily ignore the interrupt while it is still stored in the flip-flop. When the microprocessor re-enables the interrupt, the MPU proceeds to execute the A to D service routine.

8-B-264. The address decoder inputs are A0 and A1 from the address bus and the microprocessor R/$\overline{\text{W}}$ signal. $\overline{\text{CBE}}$ is the mnemonic for "Converter Block Enable" and provides a block address line, or enable, for all A to D converter operations.

Table 8-B-7. Address Decoder Truth Table

$\overline{\text{CBE}}$	R/$\overline{\text{W}}$	A1	A0	Action	Address Decoder Signal (Active Low)
0	0	1	1	Enable Control Register, U59	V
0	0	1	0	Write to Channel Address Latch U63	U
0	0	0	1	Clear interrupt latch U54B	T
0	0	0	0	Enable low A to D byte via U56B	S
0	1	1	1	Enable high A to D byte via U56A	R
0	1	1	0	Clock A to D output byte into U50	Q
0	1	0	1	Read +10 Vref Calibration number via U58	P
0	1	0	0	Read +0.5 Volt reference calibration number via U62	O
1	x	x	x	Do nothing	

NOTE

The R/$\overline{\text{W}}$ signal is not used according to convention by the A to D Converter. It serves as one of four inputs to the bus address decoder and is decoded for operations which do not involve the data bus.

8-B-265. Clock Divider (BB)

8-B-266. The Clock Divider, consisting of U55, U53A, and U54A, divides the 1 MHz input clock by 49. The resultant 20.408 kHz clock signal drives the A to D oscillator input U65-22 to determine the 100 millisecond integration period i.e., U65 allows 2048 clock transitions per integration period.

8-B-267. 5508A A3 ANALOG SUBSYSTEM TROUBLESHOOTING

8-B-268. General Measurements

8-B-269. All voltage measurements on the analog input channels including the reference voltages require high accuracy (typically within 100 µV). An HP 3456A Digital Voltmeter or equivalent is recommended for both voltage and resistance checks.

NOTE

> When making measurements near the A to D Converter, U65, avoid touching the PC board and adjacent components. Board contamination can affect A to D accuracy.

8-B-270. Latch-Up Warning

8-B-271. When an analog subsystem failure is suspected, first verify that A to D converter U65 is not in SCR latch-up. If U65 is hot enough to burn your fingers, turn off the power immediately, unplug all sensors, and wait for U65 to cool. After cooling, turn on the power and check +5V, -5V, and analog ground with respect to the rear panel. The limits on ±5V = ±250 mV, and the limits on AG = ±300 µV. If either of these supplies are pulled to ground (current limited) or if U65 heats up again, replace U65.

8-B-272. SCR latch up can occur if +5 V, - 5 V, or - 15 V is momentarily shorted to ground or to one another. Also momentary connection of any A to D digital pin to a voltage greater than ± 5 V will result in an SCR latch up. Take care to avoid this condition. If a probe slip occurs, verify the + 5 V and -5 V supplies. If either of these supplies is pulled to ground (current limited), then U65 is in SCR latchup. Latchup may also be indicated by abnormal states on the test chip (see paragraph 8-B-249, Analog Channel Scanning).

8-B-273. Preliminary Checks

a. Inspect A3 for broken traces, foreign material, damaged components, etc.

b. Check that the two edge connectors are seated properly.

c. Verify Analog Subsystem Troubleshooting Specifications in paragraph 8-B-274.

8-B-274. Analog Subsystem Troubleshooting Specifications

a. Measure the following voltages and resistances between the indicated test points and the 5508A rear panel.

TP39, Analog ground = 0V ±300 µV dc. Maximum noise = 200 µV

TP39, Analog ground: Resistance between TP39, AG, and Rear Panel = 300 mohm (max)

U65 pin 36, +0.5 Vref = +0.5 ±10 mV

TP40, +10 Vref = +10 V ±10 mV

U65 pin 40, 5 V = 5 V ±250 mV

U65 pin 28, -5 V = -5 V ±250 mV

+15 V = ±300 mV

-15 V = ±300 mV

TP 36 = 20.408 kHz TTL level clock

b. Check that the value of Cal A displayed at power-up agrees with the CAL A setting on A3S1. See Table 4-1, for binary/decimal equivalents.

c. Check that the value of CAL B displayed at power-up agrees with CAL B setting on A3S2. See Table 4-2 for binary/decimal equivalents.

8-B-275. Sensor Data Errors

8-B-276. A to D conversion errors or faulty sensors will cause error messages to be displayed on the 5508A (see Paragraph 8-A-5, 5508A Error Messages). Probe data can be observed directly either in english or metric units by procedures given in the front panel key descriptions in Section III. Front panel symptoms and the isolation procedures and information in Section 8-A should be sufficient to identify causes of gross failures. The accuracy of the A/D Converter can be verified using Paragraph 8-B-313, the A to D Converter Accuracy Test. The accuracy of the Air and Material sensors however, can only be verified as outlined in the Calibration Procedures in Section IV.

8-B-277. 10751A/B and 10757A/B/C Signal Characteristics

8-B-278. Temperature Measurements

8-B-279. The 10751A/B and the 10757A/B/C generate dc signal voltages that decrease linearly with increasing temperature. The voltages are bipolar and centered (0 volts) at approximately 25°C (77°F). The 5508A displays an error message if the temperature signal exceeds the ±1V range of the Analog-to-Digital converter. The temperature measurements require +15V and -15V supplies and +10 Vref from the 5508A. Note that the temperature sensors are calibrated for 0°C to 40°C operation which does not require the full ±1 Volt range of the A to D.

8-B-280. Pressure Measurement

8-B-281. The 10751A/B generates a dc signal voltage that decreases linearly with increasing air pressure. If the air pressure signals exceed ±1 Volt, the 5508A displays an error message. The 10751A/B pressure measurements require +15 V and -15 V, +10 Vref is not used.

8-B-282. Humidity Switch

8-B-283. The humidity switch sends one of three voltages to the 5508A:

Humidity Switch Setting	Voltage
75%	0.7 V (approx)
50%	0.0 V
25%	-0.7 V (approx)

8-B-284. Unused 10757A/B/C and 10751A/B Connectors

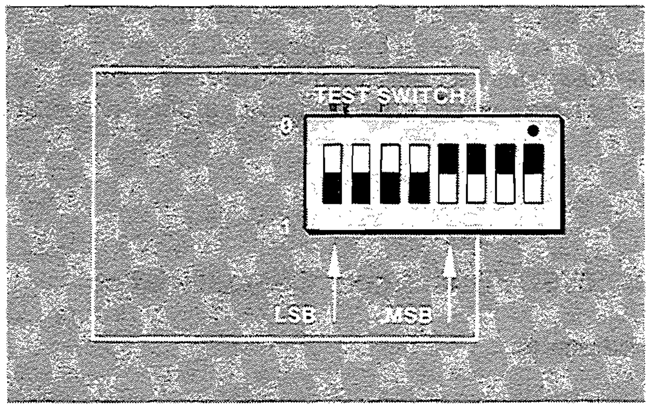
8-B-285. Connectors are provided on the rear panel of the 5508A for interconnection with the Air Sensor and three Material Temperature Sensors. When the connectors are not used, the corresponding A to D input channels pull up to approximately 2.5 Volts. Input channel voltages greater than 1.6 Volts are interpreted by the 5508A as unused. The Air Sensor uses three input channels and each Material Temperature Sensor uses one. If any of the three Air Sensor input channels is intrepreted as unused, the 5508A ignores the Air Sensor.

8-B-286. Voltmeter Mode

8-B-287. The Voltmeter mode displays Analog Subsystem measurements on the front panel and is very useful for troubleshootng the analog circuitry. During this mode, the voltage of the selected input channel is displayed to six decimal places. If the input exceeds the ± 1 Volt range of the A to D Converter, the number "1" appears in the left most digit of the display. When this occurs, the six digit number is invalid. Always check the leftmost digit when using the Voltmeter mode.

8-B-288. Setup the Voltmeter mode as follows:

a. Set TEST SWITCH A2S3 as shown below:



b. Turn POWER switch to ON (the 5508A only reads the TEST SWITCH on power up or after MASTER RESET switch A2S2 is pressed).

c. Select the input channel using the "VOLT TEST CHAN" switches (P/O A3S2).

d. Input channel selection can be verifed by using a logic probe on TEST CHIP A3U64.

Table 8-B-8. A to D Channel Selection

Volt Test Channel	Enabled Channel
000	Analog Ground
001	Air Temperature
010	Air Pressure
011	Air Humidity
100	Material Temperature 1
101	Material Temperature 2
110	Material Temperature 3
111	+0.5 Vref

Input channel selection can be verified by using a logic probe on TEST CHIP A3U64.

8-B-289. Troubleshooting Procedure for "FAIL 4" Error Message

8-B-290. Use the following procedures if the 5508A has at least displayed "PASS 1", "PASS 2", and "PASS 3" on power up.

8-B-291. Test 4 of the 5508A power up self test verifies operation of A to D Converter U65, the digital control circuitry associated with the analog subsystem, and partially verifies analog ground. Test 4 will not detect errors in the digital calibration nor an out of tolerance condition of +0.5 Vref.

8-B-292. First, the A to D Converter converts +0.5 Vref and the processor verifies that the A to D output is within 3 bits of full scale. Next, the analog ground channel is enabled and the processor verfies that the A to D output is within 3 bits of zero.

8-B-293. Procedure

a. Remove all instrument connections from the 5508A rear panel and restart the self test by pressing A2S2, MASTER RESET. If the Analog Subsystem Troubleshooting Specifications check out OK, continue with the procedure. Otherwise, refer to the appropriate troubleshooting procedure for the measurements that are out of specification limits.

b. With the 5508A flashing FAIL 4, use a logic probe or logic clip at TEST CHIP U64 to identify which A to D input channel is enabled. During the A to D portion of the self test, the A to D first converts +0.5 Vref, then converts Analog ground. The conversion which caused the self test failure can be identified by noting which channel remains enabled when FAIL 4 is displayed.

   1. If U64 pin 8 is high, the failure occurred during the +0.5 Vref conversion.
   2. If U64 pin 1 is high, the failure occurred during the Analog ground conversion.
   3. Check pins 1 through 8 of U64. If a pin other than 1 or 8 is high or more than one pin is high or none is high, then the failure is due to the digital circuitry of the Analog Subsystem. In this case, see Paragraph 8-B-296 Analog Subsystem Digital Circuitry Troubleshooting.

c. +0.5 Vref Conversion Troubleshooting

   1. Verify again that FAILS 4 is flashing and U64 pin 8 is high, U64 pin 1-7 are low.
   2. Verify U60 pin 16 is high.
   3. Verify JMP 5 is in the NORM position.
   4. Measure Voltage at U65 pin 35. If the channel multiplexer is working properly, the voltage measured should equal +0.5 Vref ±100 μV. If so proceed to step 5. Otherwise, use JMP 5 to isolate between the channel multiplexer, U65 and the unplugged comparator. U65 pin 35 should float with JMP 5 to TEST. Use Paragraph 8-B-308 Multiplexer Troubleshooting to test U60.
   5. Use paragraph 8-B-301, Interrupt Latch Troubleshooting. A +0.5 Vref conversion failure at power up can occur if the Analog Subsystem Interrupt signal $\overline{\text{IN4}}$ is not working properly.
   6. Run the 5508A in Voltmeter mode according to Paragraph 8-B-286. Set VOLT TEST CHAN switches 111 to enable the +0.5 Vref input channel. Press A2S2 MASTER RESET and note the displayed voltage. The 5508A dhould display the value of CAL B switches ±732 μV. Read the CAL B switches and find the expected display value in Table 8-B-11 ±0.5 Vref Calibration Table. If the display does not indicate the value of CAL B ±732 μV, first verify that the CAL B switches are being properly read by the 5508A according to Paragraph 8-B-294 Digital Calibration Switches Troubleshooting.
   7. Use Paragraph 8-B-310 A to D Troubleshooting and Paragraph 8-B-313 A to D Converter Accuracy Test to find the problem which is probably a failure within Block FF.

d. Analog Ground Conversion Failure

1. If the Analog Ground Conversion causes FAILS 4 and the +5 Vref conversion passed, the Interrupt latch, power supplies and digital circuitry are probably OK.
2. Verify the Analog Ground Specifications.
3. If OK, first check U66 using Paragraph 8-B-308 Multiplexer Troubleshooting.
4. Next, use Paragraph 8-B-310 A to D Converter Troubleshooting and Paragraph 8-B-313 A to D Converter Accuracy Test to troubleshoot Block FF A/D Converter.

8-B-294. Digital Calibration Switches Troubleshooting

8-B-295. The digital calibration numbers (CAL A and CAL B) are displayed during the power up self test.

a. Verify that the numbers displayed agree with the numbers on the calibration sticker. Choose the next step from 1 through 3 below.

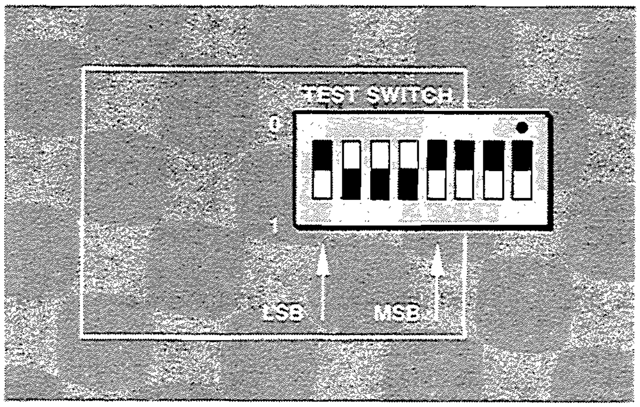
1. If not, check the settings of the CAL A and CAL B switches and use a logic probe to verify the settings electrically.
2. If the settings agree with the sticker but the displayed numbers do not, use the A to D Digital Circuitry Troubleshooting Procedures and check pins 1 and 19 on U58 and U62 to verify operation of the switch buffers.
3. If the signatures and switch settings are correct, the buffers, U58 and U62 or the switches may be defective. The switches and buffers can be completely checked using Paragraph 8-B-299 Calibration Number Buffer Verification located at the end of the Digital Circuitry Troubleshooting Procedures.

8-296. A to D Digital Circuitry Troubleshooting Procedure

8-297. The operation of the A3 digital circuits associated with the Analog Subsystem can be verified using signature analysis. Before testing the signatures, check the 5 Volt test signature to ensure that the desired program is running. Where appropriate, signal paths leading to a node that gives an incorrect signature should be traced back until a correct signature is found. The faulty node should then be apparent and if the bad component is not obvious, current tracing or other techniques will be required. The integrity of traces attached to a bad node should always be verfied before any components are replaced. Whenever a correct signature is the last one given along a signal path, verify that all traces leading from that node are also OK.

8-298. Procedure

a. Set processor board A2 switches and jumpers as follows:



JMP 1: Norm
JMP 2: Installed

b. Set all A3 Jumpers to NORM.

c. Set 5005A Signature Multimeter controls as follows:

CLOCK: Negative edge
START: Negative edge
STOP: Positive edge

d. Connect the 5005A Pod leads to the test points on A2:

GROUND: TP8
CLOCK: TP9
STOP: TP10
START: TP11

e. To measure signatures, toggle the MASTER RESET switch A2S2 and check the following nodes:

1. +5 V Test Signature = H9AC
2. The following is a list of signatures for the entire analog circuitry. Start off by taking the signatures marked with an (*). If they are all O.K., then this portion of the troubleshooting procedure passes. If any are bad, refer to the schematic diagram Figure 8-B-21 sheet 4, check back until the faulty IC is found using the signatures given below.

U50 Pin No.	U51 Pin No.	U52 Pin No.	U53 Pin No.
1: U212*	1: 45F4	1: 0000	1: AU03
19: U212	2: U211	2: H9AC	2: 2111
	3: 8701	3: H9AC	3: 0000
	4: U1U1	4: 0000*	4: 0U35
	5: 0000	5: ———	5: U8CA
	6: H9AC	6: ———	6: 0U35
	7: 2045	8: H69P	8: ———
	9: 0696	9: 0U35	9: 1HH8*
	10: U212	10: U8CA	10: ———
	11: A238	11: 2111	
	12: UUU1	12: ———	
	13: 0532	13: ———	
	14: PC7H		
	15: 4U1H		

U54 Pin No.

1: H9AC
2: 0000
3: 0000
4: 5772
5: AU91*
8: ———
10: 0532*
11: H9AC
12: 0000
13: H9AC

U55 Pin No.

1: 0000
2: AU91
6: AFHA
10: 2111
11: AU03
12: AU91
13: AFHA

U56 Pin No.

1: 4181
2: 0000
3: U212
4: A238
6: FP67
8: 4181
10: UUU1
11: U212
12: 0000
13: FP67

U58 Pin No.

1: 0696*
19: 0696

U59 Pin No.

1: 4U1H*
2: 5772
5: OU35
7: C4H4
9: 0000
10: 1HH8

U60 Pin No.

1: 83CC*
8: 969A
9: 81P6
16: PP3F

U62 Pin No.

1: 2045*
19: 2045

U63 Pin No.

1: PC7H*
2: 4APP
5: 81P6
6: 969A
9: 83CC
11: 0000
12: 512U
15: HC87
16: 6316
19: PP3F

U65 Pin No.

2: ———
18: 4181*
19: FP67*
22: H69P*
26: C4H4*

U66 Pin No.

1: HC87*
8: 512U*
9: 6316*
16: 4APP*

8-B-299. Calibration Number Buffer Verification

8-B-300. This procedure checks the operation of the calibration number buffers U58 and U62.

NOTE

It is only necessary to perform this verification if you suspect the calibration number buffers are bad. For example, if the "CAL A" or "CAL B" values displayed at power-up are different than the values actually entered on the "CAL A" or "CAL B" dip switches. "FAIL 4" is not sufficient reason to suspect faulty calibration number buffers.

NOTE

Write down the CAL A and CAL B switch settings because the following procedures require changing their positions for troubleshooting. If recalibration is not necessary, return the switches to their original values.

a. Perform steps a through e of the Analog Subsystem Digital Circuitry Troubleshooting Procedure.

b. On A2, remove the Signature Analysis "STOP" line from the "STOP" pin. Place the HP5005 in the "QUAL" mode by pressing the "QUAL" key.

c. Set the "QUAL" to trigger on a logic low.

d. Jumper the red 5005 lead (QUAL) to U58 pin 1 or 19. Press MASTER RESET, and measure the following signatures, toggling each dip switch position in "CAL A" to both a "0" and a "1".

+5 V test = 826P

U58 Pin No.	Switch = 0	Switch = 1
3	0000	826P
5	0000	826P
7	0000	826P
9	0000	826P
12	0000	826P
14	0000	826P
16	0000	826P
18	0000	826P

If any of the signatures are incorrect, check the inputs of U58 while toggling each switch position to verify proper switch operation.

e. Remove the red "QUAL" lead from U58 and connect it to U62 pin 1 or 19. Press MASTER RESET and measure the following signatures, toggling each dip switch position in "CAL B" and "VOLT TEST CHAN" to both a "0" and a "1".

+5 V test = 826P

U62 Pin No.	Switch = 0	Switch = 0
3	0000	826P
5	0000	826P
7	0000	826P
9	0000	826P
12	0000	826P
14	0000	826P
16	0000	826P
18	0000	826P

If any of the signatures are incorrect, check the inputs of U62 while toggling each switch position to verify proper switch operation.

8-B-301. Interrupt Latch Troubleshooting

8-B-302. Use the following procedures to verify or troubleshoot the Interrupt Latch, Block AA. Interrupt latch failures will cause TEST 4 of the 5508A self test to fail (FAIL 4).

8-B-303. Procedure

a. Run the 5508A in the Voltmeter Mode according to Paragraph 8-B-286 Enable the Analog ground input channel (VOLT TEST CHAN = 000).

b. Press A2S2, MASTER RESET.

c. Verify A3U53 pin 9 is low. (In Voltmeter Mode, the 5508A sets pin 9 low to disable the Interrupt Latch circuitry).

d. Using a logic probe at TP 37 $\overline{\text{STATUS}}$, verify that the U65 STATUS output is toggling. If U65 pin 2, STATUS, is not toggling with a period of about 400 msec, then go to A to D Converter Troubleshooting, Paragraph 8-B-310.

e. Use a logic probe to verify U54 pin 8 is high.

f. Using an HP 546A Logic Pulser, inject single pulses at U54 pin 10. U54 should clear (pin 8 goes low) each time pin 10 is pulsed. Note that pin 8 should be returned high quickly (reset) by the steadily toggling $\overline{\text{STATUS}}$ signal.

g. Verify that U53 pin 9 is still low following step f.

h. Move logic probe to U52 pin 6 and verify that it is still high (with U53 pin 9 set low by the processor $\overline{\text{IN4}}$ should not go true).

i. Move logic pulser to U53 pin 9 and apply a single pulse. $\overline{\text{IN4}}$ should drop low and stay low indicating that the interrupt signal (U54 pin 8 high) was successfully passed by U53C and that the interrupt was received by the processor. The processor responds (in Voltmeter Mode) by pulling U53 pin 9 high without clearing U54B). If $\overline{\text{IN4}}$ pulses low and returns high then the processor is not receiving the interrupt signal. Check the Priority Interrupt circuitry on the A2 Processor Board.

8-B-304. Unplugged Comparator Troubleshooting

8-B-305. Should plugged-in probes read unplugged or unplugged probes read plugged-in, use the procedures in the front panel key descriptions in Section III to check for proper operation and correct sequences.

8-B-306. Preliminary Checks

a. Check for the proper power supply voltages:

   1. +15 V: U60 and U66 pin 12
   2. -15 V: U60 and U66 pin 5
   3. Gnd: U60 and U66 pin 4

b. Check that JMP 5 is in the NORM position.

8-B-307. Procedure

a. Turn 5508A power off.

b. Lift anode lead of CR5 from PC board and ground it.

c. Configure the 5508A for Voltmeter Mode according to Paragraph 8-B-286. Install a variable DC source on the suspected input channel and set the source for 0 volts. Turn 5508A power on.

d. Measure voltage at U57 pin 2. It should be 1.1 V ±0.1 V.

e. Measure voltage at U57 pin 3. It should be the same as the input voltage ±100 uV.

f. Adjust the input voltage from 0 V to 1.6 V while monitoring U57 output at pin 7. U57 output should drop to a TTL logic "0" (0.8 V max) at 1.5 V ±0.1 V.

8-B-308. Multiplexer Troubleshooting

8-B-309. If the Multiplexers are not working properly, the input voltages will not pass correctly to the input of the A to D Converter. Verify the Multiplexers operation using the following procedure.

a. Turn 5508A off.

b. Configure the 5508A for Voltmeter mode according to Paragraph 8-B-286.

c. Select the suspect input channel using the VOLT TEST CHAN switches and verify that the corresponding input voltage is passed to the A to D Converter input pin. The voltage at the input pin should be the input channel voltage ±100 uV. If not, verify that the appropriate Multiplexer (U60 or U66) is properly enabled before replacing it.

8-B-310. A to D Converter Troubleshooting

8-B-311. Use the Voltmeter Mode, Paragraph 8-B-286, to troubleshoot the A to D Converter Block FF. Table 8-B-9 lists possible symptoms for hardware failures in the Voltmeter Mode. The table can also be used "backwards". For example, entry No. 1 of the table indicates that with the Integrator capacitor C48 shorted, the A to D Converter should read all input voltages as zero volts. Thus, the capacitor can be shorted with a test lead and if the display indicates 0 Volts for all input voltages then the remaining components of Block FF are probably functioning properly.

Table 8-B-9. A to D Converter Troubleshooting

Failure	Symptom
Integrator Capacitor C48 shorted or open	A to D Converter reads all input voltages as zero volts.
Auto Zero capacitor C61 shorted or leaky	Readings are offset approximately the same amount and direction for both positive and negative input voltages.
Auto Zero capacitor C61 open	A to D Converter reads all input voltages as over ranged
Integrator capacitor C48 leaky	A to D Converter reads all input voltages, both positive and negative at a lower magnitude

8-B-312. Check the internal timing circuits of U65 as follows:

a. Run the 5508A in Voltmeter Mode with the VOLT TEST CHAN switches set to enable Analog ground (000).

b. Check the following:

   1. Verify that the STATUS output pin is toggling with a period of approximately 400 msec.

   2. Verify U52F by checking for $\overline{\text{STATUS}}$ at TP 37.

   3. If the STATUS signal is not correct, verify that the 20.408 kHz clock input at U65 pin 22 is present. Also verify that U65 pin 26 is high and not being pulsed low.

   4. If all three pins check out ok but the STATUS output is not a periodic square wave, then replace U65.

c. Check the internal timing of U65 as follows:

   1. Press A2S2 MASTER RESET with the 5508A still set to VOLTMETER MODE.

   2. Configure the HP 5005A Signature Multimeter in totalize mode and connect as follows:

      START lead to A3TP37 $\overline{\text{STATUS}}$, set START polarity to positive.
      STOP lead to A3TP37 $\overline{\text{STATUS}}$, set STOP polarity to negative.
      Data Probe to A3TP36, 20.408 kHz clock.

   3. With data probe to A3TP36, totalize measurement should be 2048 counts.

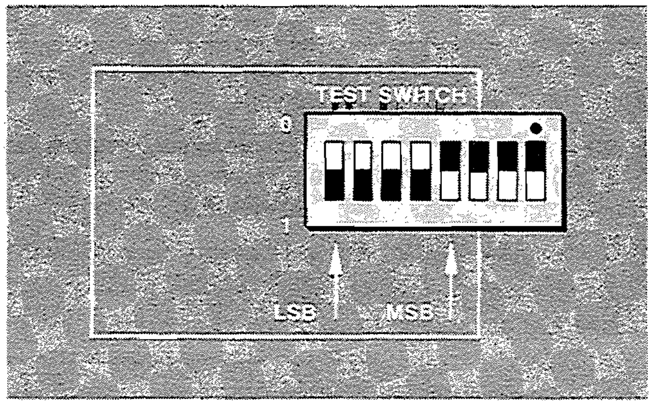
8-B-313. A to D Converter Accuracy Test

8-B-314. This test checks the operation of the analog input circuits, multiplexers, and the A to D converter. A known voltage, preferably ground but no greater than ±1 volt DC, is used to exercise the measurement inputs. (Consult Paragraph 8-A-286 Voltmeter Mode for references). If the test does not operate as described, first use the A to D Digital Circuitry Troubleshooting Procedure, Paragraph 8-A-296 to verify operation of the digital control circuits.

8-315. Procedure

a. Disconnect all sensors from the 5508A.

b. Set TEST SWITCH, A2S3 as shown below and toggle MASTER RESET A2S2.



c. Set the "Volt Test Chan" switch (P/O A3S1) on A3 to select the desired analog channel using Table 8-B-8, A to D Channel Selection. Proper input channel selection should be verified using a logic probe on the TEST CHIP A3U64.

d. Apply known voltage (-1 to +1 Vdc) to the appropriate pin on the input side of resistor network A3R56. Use a variable DC source and monitor its output with an HP 3456A DVM for comparison to the 5508A display.

e. Read voltage from 5508A display and check against known value.*

f. If no gross failures exists but the A to D specifications as listed in Table 8-B-10 are not satisfied, the 5508A should be recalibrated according to Section IV. If the accuracy tests fail following recalibration, first verify the calibration switches (CAL A AND CAL B) according to Paragraph 8-B-294 Digital Calibration Switches Troubleshooting.

**If there is no input voltage on a selected channel or the input voltage exceeds 1 volt the 5508A display indicates over range with a "1" in the leftmost digit and an invalid six digit voltage.*

8-B-316. Before troubleshooting the A to D Converter, Block FF, verify that the input channel and multiplexer are working properly. Verify that the Analog Subsystem Troubleshooting Specification, Paragraph 8-B-274 are satisified.

Table 8-B-10. A to D Converter Accuracy Test Specifications

Selected Channel	5508A Display Value
Analog Ground	0 ± 244 µV
+0.5 VRef	*B ± 488 µV
−1 to +1 Volt Input Voltages (V)	± 732 µV

**Value of B taken from Table 8-B-11 +0.5 Vref Calibration Table*

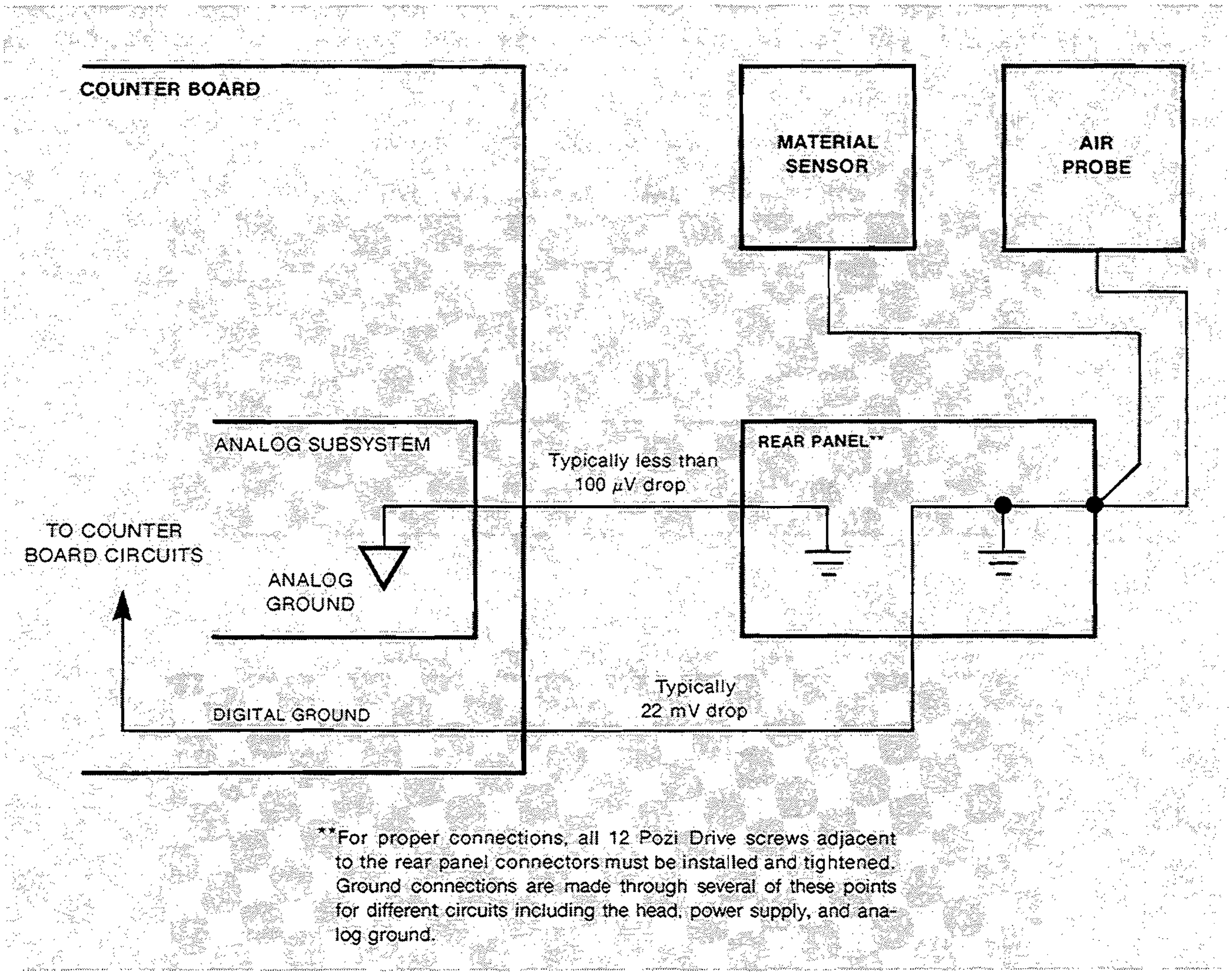
If the +0.5 Vref channel fails this test, the 5508A may be reading the CAL B switch improperly. See Paragraph 8-B-299, Calibration Number Buffer Verification.

Table 8-B-11. ±0.5 Vref Calibration Table

CAL B	B	CAL B	B
0	0.498720	16	0.500000
1	0.498800	17	0.500080
2	0.498880	18	0.500160
3	0.498960	19	0.500240
4	0.499040	20	0.500320
5	0.499120	21	0.500400
6	0.499200	22	0.500480
7	0.499280	23	0.500560
8	0.499360	24	0.500640
9	0.499440	25	0.500720
10	0.499520	26	0.500800
11	0.499600	27	0.500880
12	0.499680	28	0.500960
13	0.499760	29	0.501040
14	0.499840	30	0.501120
15	0.499920	31	0.501200

8-B-317. Analog Ground Troubleshooting

8-B-318. Due to IR drops, not all grounds in the instrument are at the same potential. For example, because of the heavy current flow in the ground line, the digital ground of A3 is typically 22 mV above rear panel ground. Since the analog subsystem must make highly accurate measurements of the sensor outputs, and because the sensors voltages are referenced to rear panel ground, a separate low current trace called "Analog Ground" is used. This line connects from the rear panel to the analog subsystem as shown below. Under normal conditions, little or no current flows through analog ground, consequently zero volts exists at both the analog subsystem and the sensors.


COUNTER BOARD
MATERIAL SENSOR
AIR PROBE
ANALOG SUBSYSTEM
Typically less than 100 µV drop
REAR PANEL**
TO COUNTER BOARD CIRCUITS
ANALOG GROUND
DIGITAL GROUND
Typically 22 mV drop

**For proper connections, all 12 Pozi Drive screws adjacent to the rear panel connectors must be installed and tightened. Ground connections are made through several of these points for different circuits including the head, power supply, and analog ground.

8-B-319. When making measurements, take care to keep the grounds separate. For example, if analog ground is shorted to digital ground, parallel paths will exist resulting in current sharing. Should this occur, the circuits referenced to analog ground will no longer be referenced to 0 Volts.

8-B-320. If a device injects excessive current into analog ground, a voltage drop will occur along the trace where the current flows. To detect IR drops, first measure at J2 and work inwards. If the voltage is higher after each measurement, excessive current is being injected on A3.

8-B-321. The point where current is injected into the trace will always be the highest voltage measured. Attempting to use a current probe and stimulate the trace with a square wave generator or pulser is not recommended as this may damage U65 or U67.

8-B-322. +10 Vref Troubleshooting

8-B-323. +10 Vref serves two important functions:

a. supplies an offset to the temperature signals from the Air Sensor and Material Temperature Sensors.

b. supplies the source for +0.5 Vref, the A to D Voltage Reference for U65.

8-B-324. If +10 Vref is out of specification as given in Paragraph 8-B-274 Analog Subsystem Troubleshooting Specifications, proceed as follows:

a. With 5508A power off, measure the resistance between TP40 (+10 Vref), and TP9 (Analog Ground). It should be approximately 10 k ohms.

b. Check resistor pack A4R1 by measuring resistance between TP40 and the appropriate pins of the rear panel connectors. Readings should be approximately 10 k ohms.

c. Remove test leads and turn 5508A power on. Check +10 Vref and analog ground according to Paragraph 8-B-274 Analog Subsystem Troubleshooting Specifications.

d. If +10 Vref is out of spec, check the +15 V supply at pin 8 of U67. If the supply is OK, replace U67 and recheck the +10 Vref output specification (10 V ±0.01 V).

e. Recalibrate +10Vref and +0.5Vref according to Section IV.

8-B-325. +0.5 Vref Troubleshooting

8-B-326. Before troubleshooting the +0.5 Vref supply, first verify that +10 Vref, U67 is in specification limits.

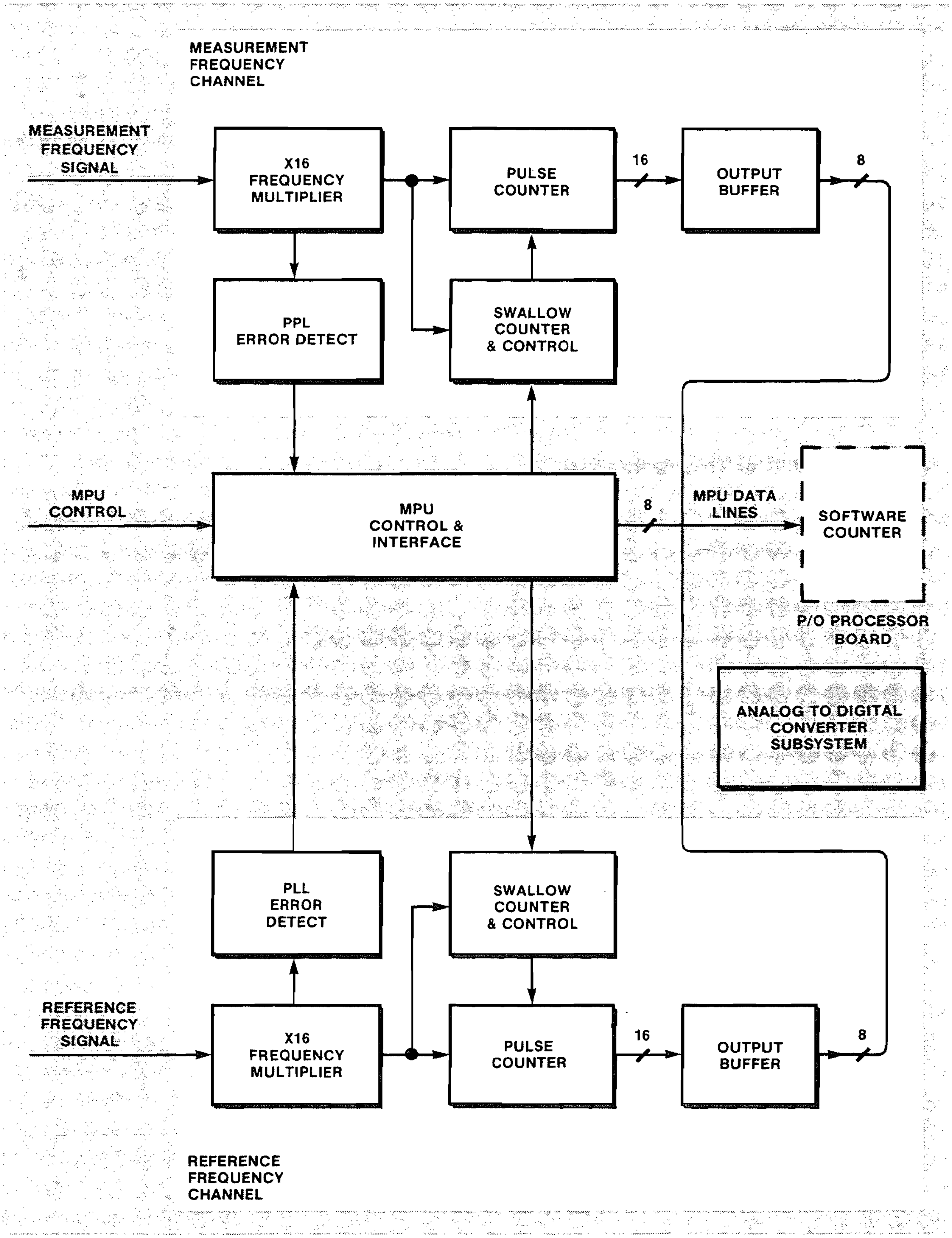
a. Measure +10 Vref at TP40. It should be 10 Volts ±0.01 V. If not go to +10 Vref troubleshooting procedure.

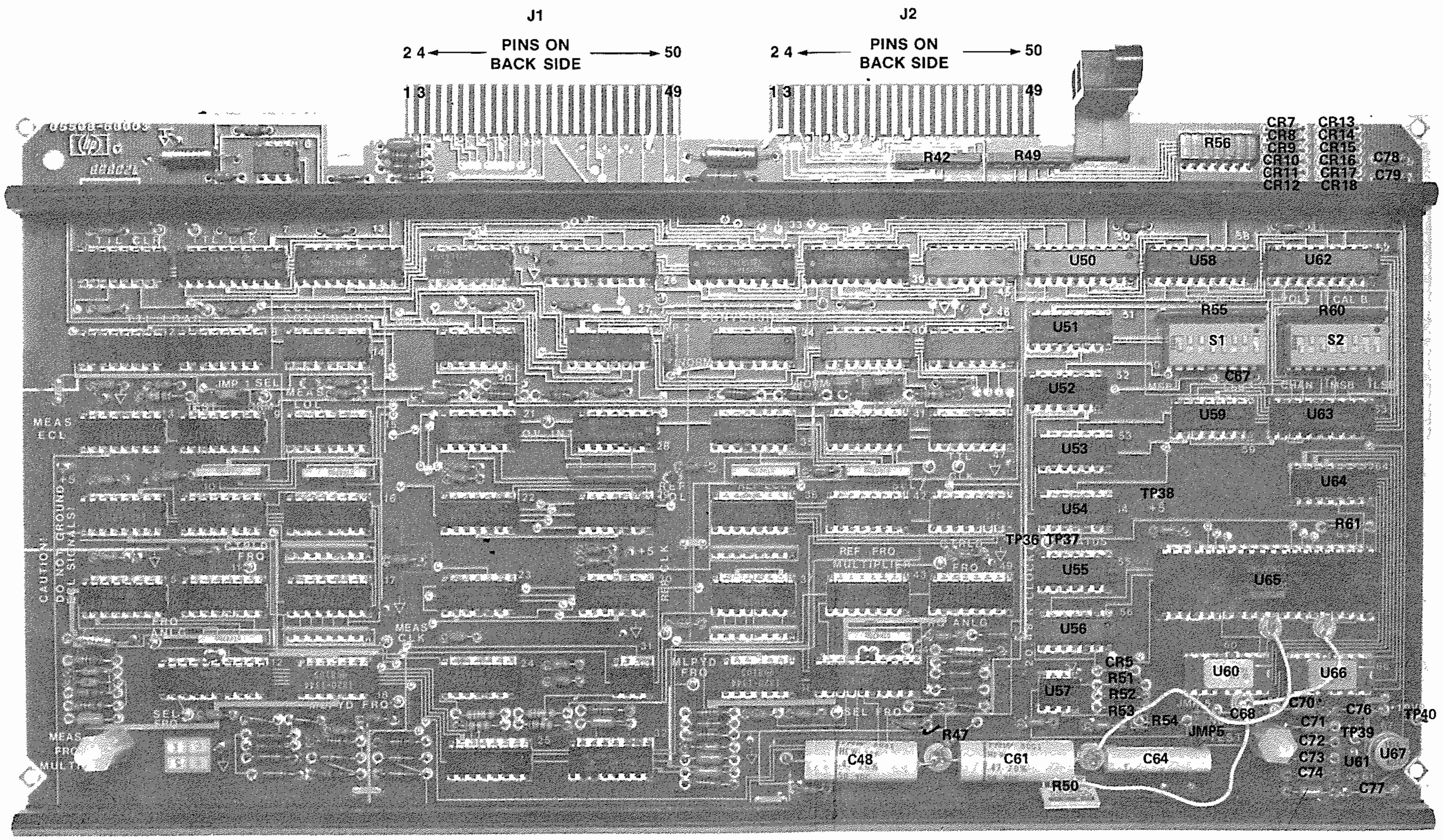
b. Verify +10 Vref at pin 1 of R50.

c. Lift the wire leading from R50 to U60 at the teflon terminal at U60.

d. Measure +5 Vref again. If it is still out of spec, replace R50. Otherwise, check for a short or bridge on the circuitry that has been isolated by lifting the wire.

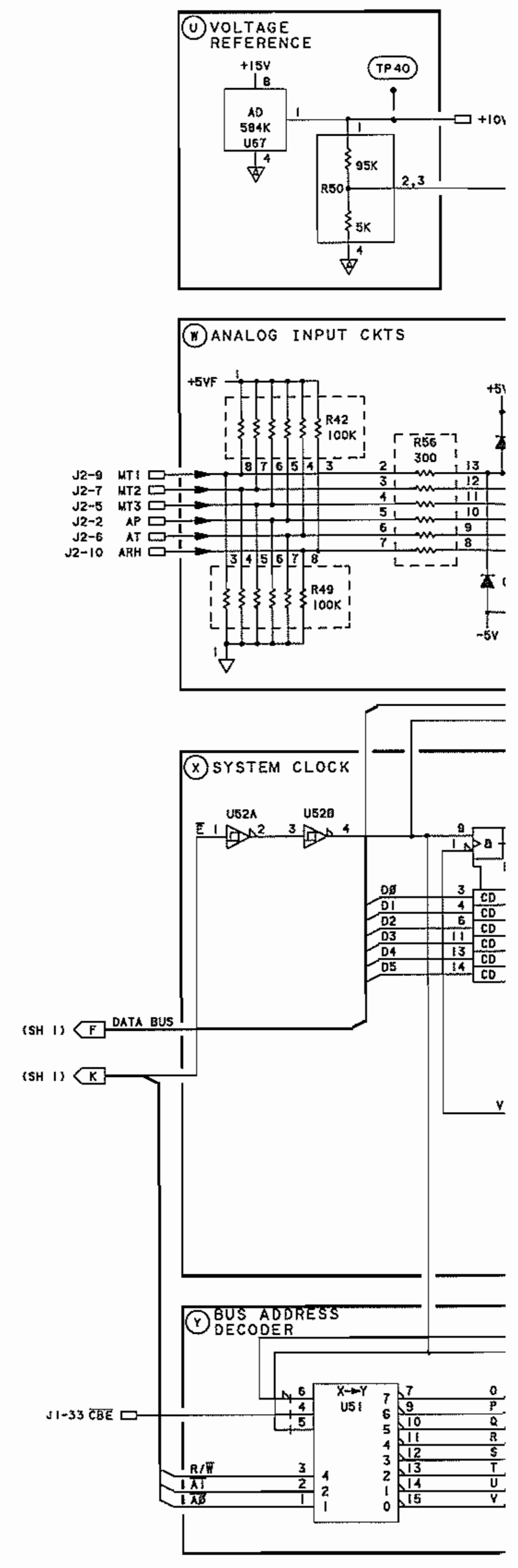
e. Recalibrate +0.5 Vref according to Section IV.

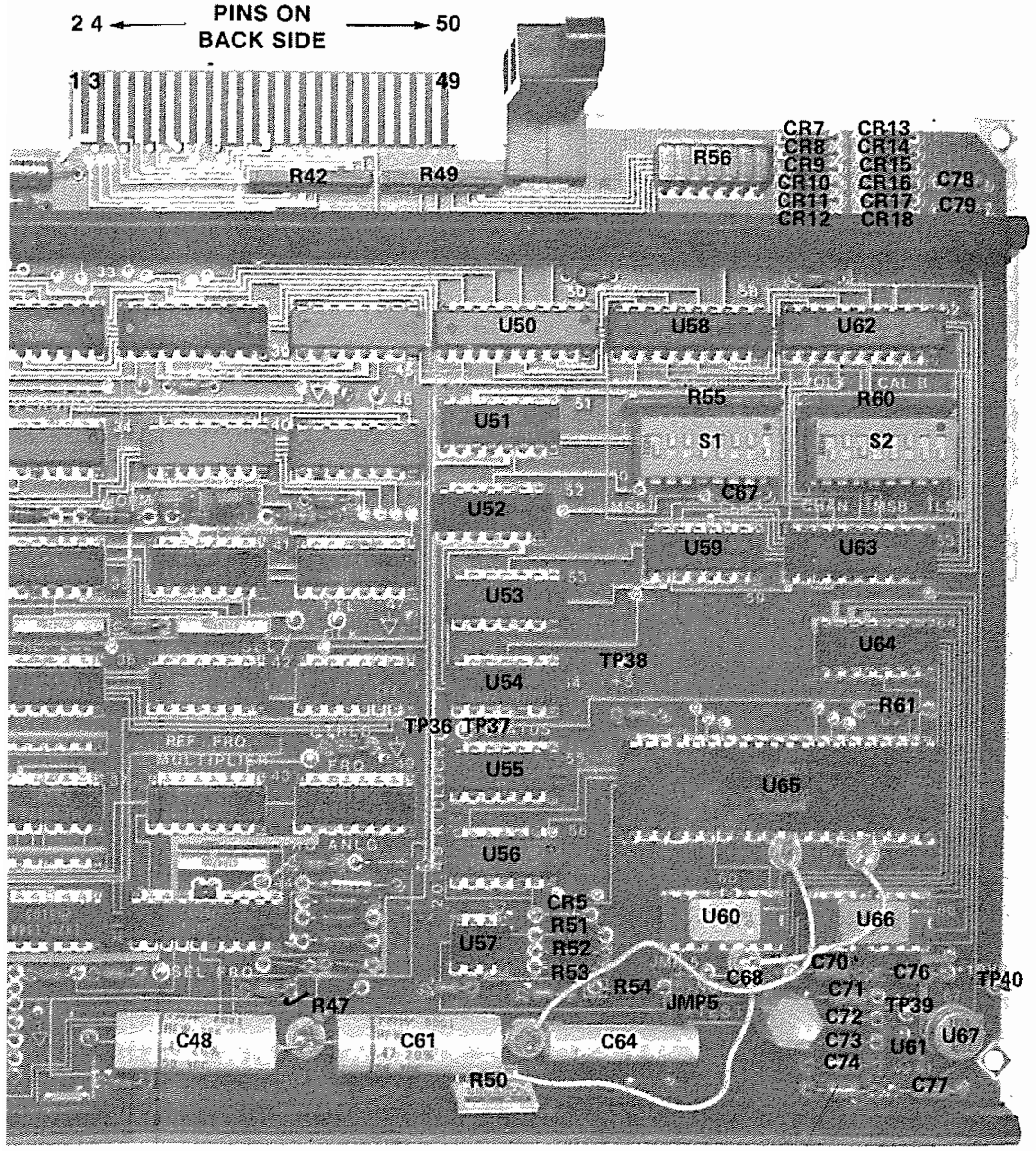

MEASUREMENT FREQUENCY CHANNEL
MEASUREMENT FREQUENCY SIGNAL
X16 FREQUENCY MULTIPLIER
PULSE COUNTER
16
OUTPUT BUFFER
8
PPL ERROR DETECT
SWALLOW COUNTER & CONTROL
MPU CONTROL
MPU CONTROL & INTERFACE
8
MPU DATA LINES
SOFTWARE COUNTER
P/O PROCESSOR BOARD
ANALOG TO DIGITAL CONVERTER SUBSYSTEM
PLL ERROR DETECT
SWALLOW COUNTER & CONTROL
REFERENCE FREQUENCY SIGNAL
X16 FREQUENCY MULTIPLIER
PULSE COUNTER
16
OUTPUT BUFFER
8
REFERENCE FREQUENCY CHANNEL


J1
2 4 ← PINS ON BACK SIDE → 50
1 3
49
J2
2 4 ← PINS ON BACK SIDE → 50
1 3
49
R42
R49
R56
CR7
CR8
CR9
CR10
CR11
CR12
CR13
CR14
CR15
CR16
CR17
CR18
C78
C79
U50
U58
U62
U51
R55
R60
S1
S2
C67
U52
U59
U63
U53
U64
TP38
U54
R61
TP36
TP37
U55
U65
U56
CR5
R51
U60
U66
U57
R52
R53
C70
C76
TP40
R54
C68
C71
JMP5
TP39
R47
C72
C48
C61
C64
C73
U61
U67
C74
R50
C77
MEAS ECL
CAUTION! DO NOT GROUND ECL SIGNALS!

THE COMPLETE COMPONENT LOCATOR FOR A3 IS SHOWN ON SHEET 5

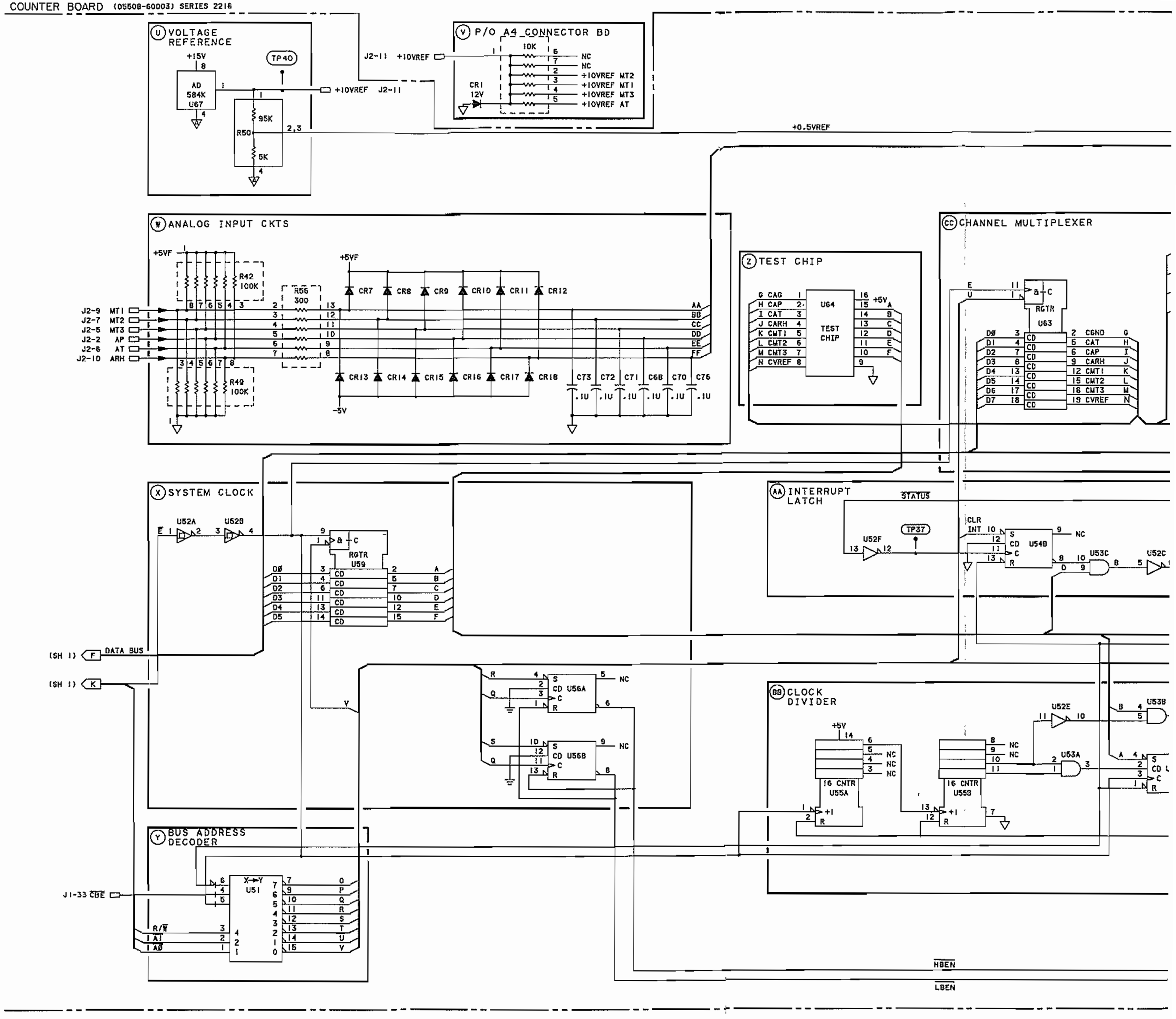
COUNTER BOARD (05508-60003) SERIES 2216


Ⓤ VOLTAGE REFERENCE
+15V
8
AD 584K U67
4
1
TP40
+10V
95K
R50
2,3
5K
Ⓦ ANALOG INPUT CKTS
+5VF
R42 100K
R56 300
+5V
J2-9 MT1
J2-7 MT2
J2-5 MT3
J2-2 AP
J2-6 AT
J2-10 ARH
R49 100K
-5V
Ⓧ SYSTEM CLOCK
U52A
U52B
D0
D1
D2
D3
D4
D5
CD
(SH 1) F DATA BUS
(SH 1) K
Ⓨ BUS ADDRESS DECODER
X→Y U51
J1-33 CBE
R/W
A1
A0
O
P
Q
R
S
T
U
V


J2
2 4
PINS ON BACK SIDE
50
1 3
49
R42
R49
R56
CR7
CR8
CR9
CR10
CR11
CR12
CR13
CR14
CR15
CR16
CR17
CR18
C78
C79
U50
U58
U62
U51
R55
R60
S1
S2
U52
C67
U59
U63
U53
U64
TP38
U54
R61
TP36
TP37
U55
U65
U56
CR5
R51
R52
R53
U57
U60
U66
C68
C70
C76
TP40
R54
JMP5
C71
TP39
C72
C73
U61
U67
C74
C77
R47
C48
C61
C64
R50

PONENT LOCATOR
N ON SHEET 5

COUNTER BOARD (05508-60003) SERIES 2216


U VOLTAGE REFERENCE
+15V
AD 584K U67
TP40
95K
R50
5K
+10VREF J2-11
J2-11 +10VREF
V P/O A4 CONNECTOR BD
10K
CR1 12V
NC
+10VREF MT2
+10VREF MT1
+10VREF MT3
+10VREF AT
+0.5VREF
W ANALOG INPUT CKTS
+5VF
R42 100K
R56 300
J2-9 MT1
J2-7 MT2
J2-5 MT3
J2-2 AP
J2-6 AT
J2-10 ARH
CR7
CR8
CR9
CR10
CR11
CR12
CR13
CR14
CR15
CR16
CR17
CR18
R49 100K
-5V
C73
C72
C71
C68
C70
C76
.1U
AA
BB
CC
DD
EE
FF
Z TEST CHIP
G CAG
H CAP
I CAT
J CARH
K CMT1
L CMT2
M CMT3
N CVREF
U64
TEST CHIP
+5V
CC CHANNEL MULTIPLEXER
RGTR
U63
D0
D1
D2
D3
D4
D5
D6
D7
CGND
CAT
CAP
CARH
CMT1
CMT2
CMT3
CVREF
X SYSTEM CLOCK
U52A
U52B
RGTR
U59
A
B
C
D
E
F
(SH 1) F DATA BUS
(SH 1) K
U56A
U56B
NC
AA INTERRUPT LATCH
STATUS
U52F
TP37
CLR INT
U54B
U53C
U52C
BB CLOCK DIVIDER
+5V
16 CNTR U55A
16 CNTR U55B
U52E
U53B
U53A
Y BUS ADDRESS DECODER
J1-33 CBE
X→Y U51
R/W
A1
A0
O
P
Q
R
S
T
U
V
HBEN
LBEN

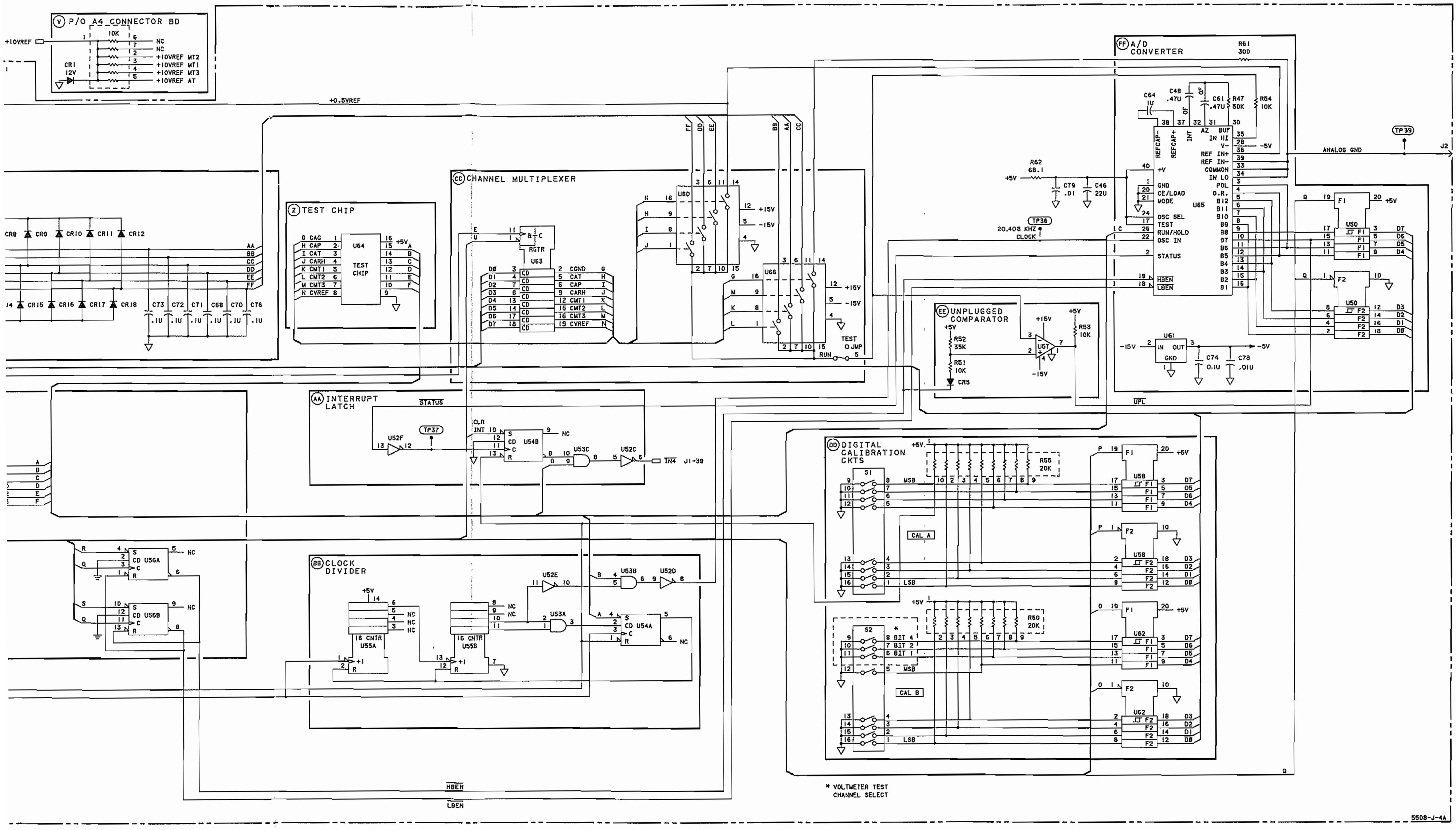

P/O A4 CONNECTOR BD
+10VREF
+10VREF MT2
+10VREF MT1
+10VREF MT3
+10VREF AT
CR1 12V
+0.5VREF
TEST CHIP
U64
CHANNEL MULTIPLEXER
U63
U60
U66
A/D CONVERTER
U65
ANALOG GND
J2
REAR PANEL
TP39
TP36
20.408 KHZ CLOCK
UNPLUGGED COMPARATOR
U57
U61
U50
INTERRUPT LATCH
STATUS
TP37
U52F
U54B
U53C
U52C
INT J1-39
CLOCK DIVIDER
16 CNTR U55A
16 CNTR U55B
U52E
U53B
U52D
U53A
U54A
U56A
U56B
DIGITAL CALIBRATION CKTS
S1
S2
R55 20K
R60 20K
CAL A
CAL B
U59
U58
U62
MSB
LSB
HBEN
LBEN
UPL
* VOLTMETER TEST CHANNEL SELECT
5508-J-4A

Figure 8-B-21. 5508A A3 Counter Board 05508-60003, Analog Subsystem (Sheet 4 of 5)

Figure 8-B-21
5508A A3 COUNTER BOARD 05508-60003,
ANALOG SUBSYSTEM (Sheet 4 of 5)

(See Page 8-B-97)

Figure 8-B-21
5508A A3 COUNTER BOARD 05508-60003,
ANALOG SUBSYSTEM (Sheet 4 of 5)

(See Page 8-B-97)

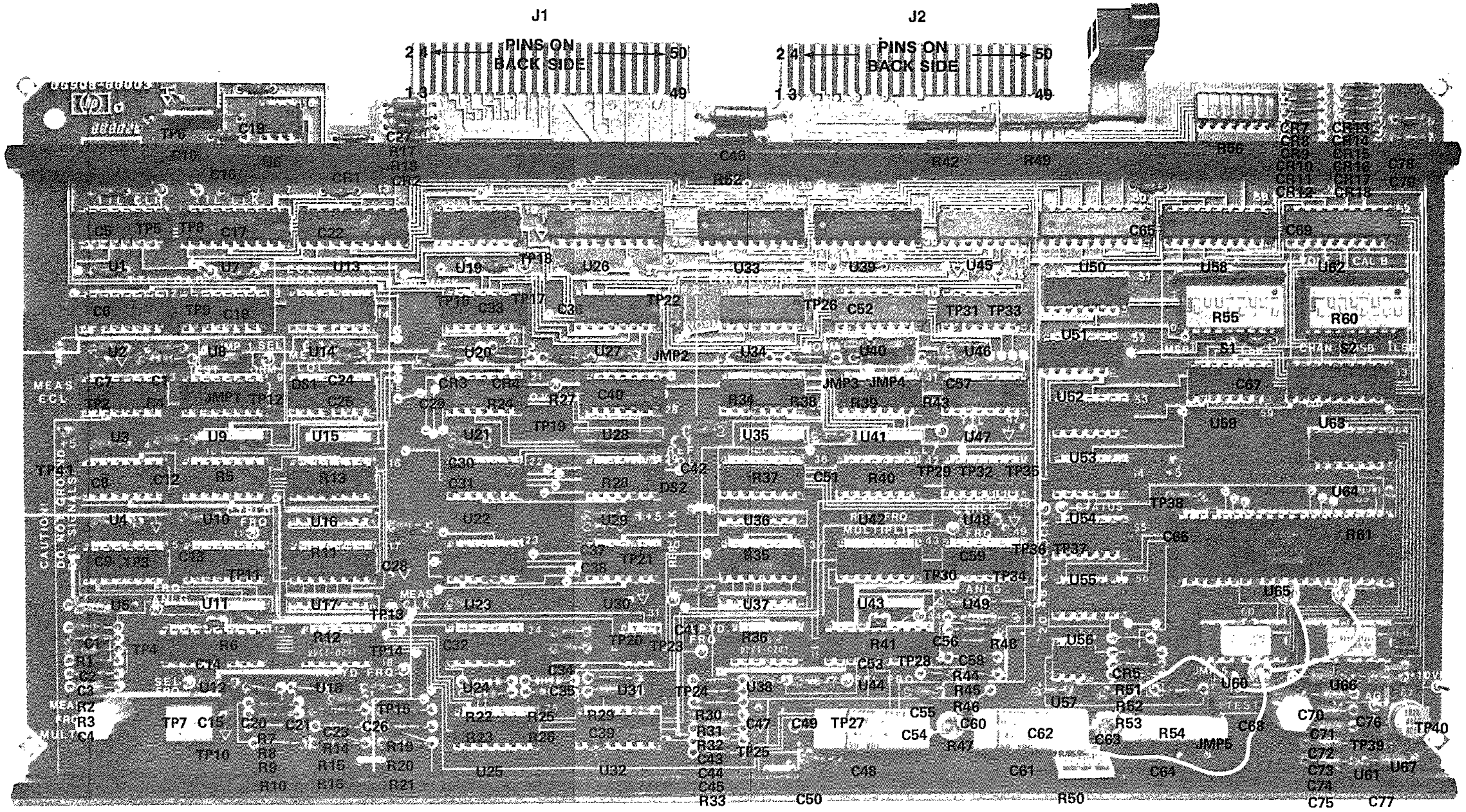

J1
PINS ON BACK SIDE
2 4
50
1 3
49
J2
PINS ON BACK SIDE
2 4
50
1 3
49
TP6
C19
C27
R17
R18
CR2
C40
R52
R42
R49
R56
CR7
CR8
CR9
CR10
CR11
CR12
CR13
CR14
CR15
CR16
CR17
CR18
C78
C79
C5
TP5
TP8
C17
C22
C65
C69
U1
U7
U13
U19
TP18
U26
U33
U39
U45
U50
U58
U62
CAL B
C6
TP9
C16
TP16
C33
TP17
C34
TP22
TP26
C52
TP31
TP33
R55
R60
U2
U8
U14
U20
U27
JMP2
U34
U40
U46
U51
S1
S2
MEAS ECL
C7
C1
JMP1
TP12
DS1
C24
C25
CR3
CR4
R24
R27
C40
JMP3
JMP4
C57
C67
TP2
R4
C29
R34
R38
R39
R43
U52
U59
U63
U3
U9
U15
U21
TP19
U28
U35
U41
U47
TP41
C8
C12
R5
R13
C30
C31
C42
DS2
R37
C51
R40
TP29
TP32
TP35
U53
U64
U4
U10
U16
U22
U29
U36
U42
U48
TP38
U54
CAUTION DO NOT GROUND SIGNALS
C9
TP3
C13
TP11
R11
C28
C37
C38
TP21
R35
C59
TP36
TP37
C66
R61
TP30
TP34
U55
U5
U11
U17
U23
U30
U37
U43
U49
U65
MEAS CLK
TP13
C1
TP4
R6
R12
TP14
C32
C41
TP20
TP23
R36
R41
C56
R48
U56
R1
C14
C2
C3
U12
U18
C34
C35
U24
U31
TP24
U38
C53
TP28
C58
R44
R45
R46
CR5
R51
R52
U60
U66
MEAS
R2
R3
C4
TP7
C15
C20
C21
C23
C26
TP15
R22
R25
R29
R30
R31
R32
C47
C49
TP27
C55
C54
C60
C62
R53
R54
C68
C70
C71
C76
TP40
TP10
R7
R8
R9
R10
R14
R15
R16
R19
R20
R21
R23
R26
C39
C43
C44
C45
R33
TP25
C48
R47
C61
C63
C64
JMP5
C72
C73
C74
C75
TP39
U61
U67
C77
U25
U32
C50
R50
U57

Figure 8-B-21. 5508A A3 Counter Board 05508-60003, Component Locator (Sheet 5 of 5)

Figure 8-B-21
5508A A3 COUNTER BOARD 05508-60003,
COMPONENT LOCATOR (Sheet 5 of 5)

(See Page 8-B-99)

8-B-327. 5508A A4 CONNECTOR BOARD CIRCUIT THEORY

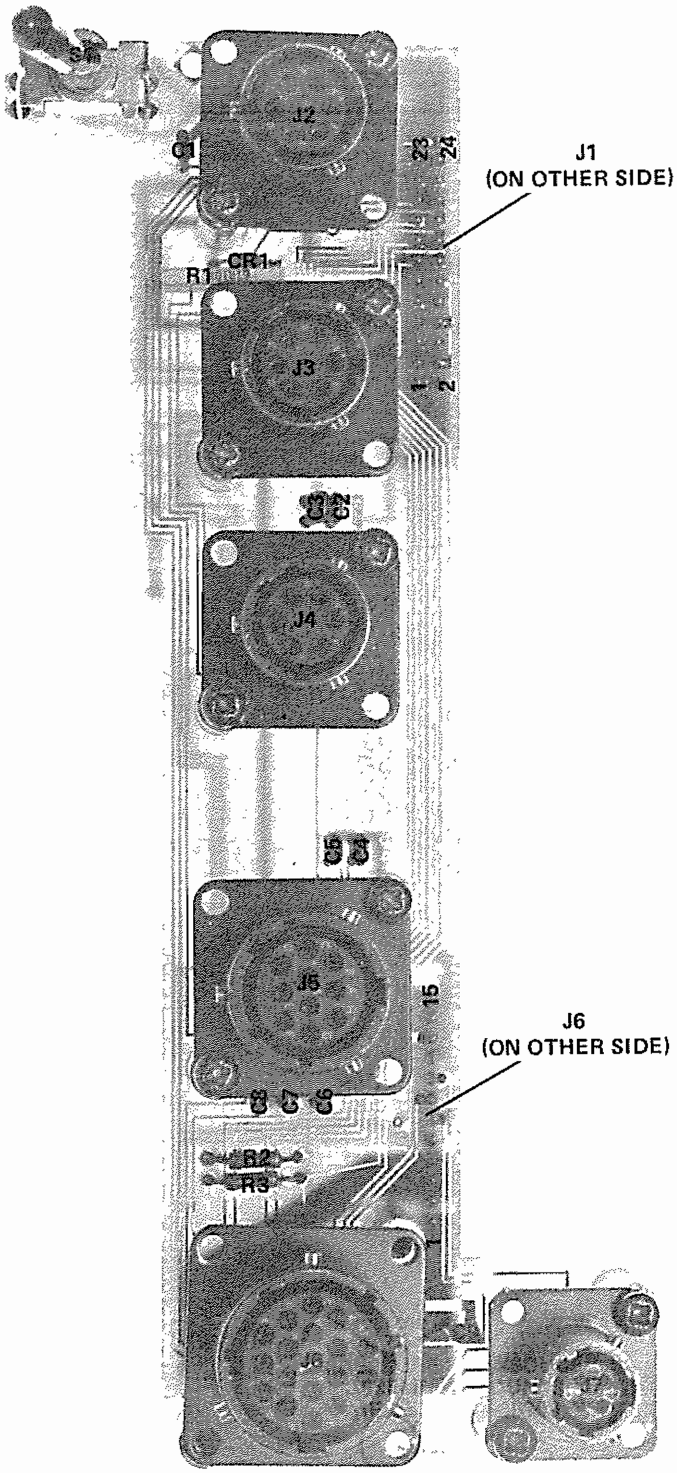
8-B-328. The connector board (Figure 8-B-22) provides interfacing of the 5508A to the 5518A Laser Head, the 10751A/B Air Sensors, the Remote Control Unit, and up to three 10757A/B/C Material Temperature Sensors.

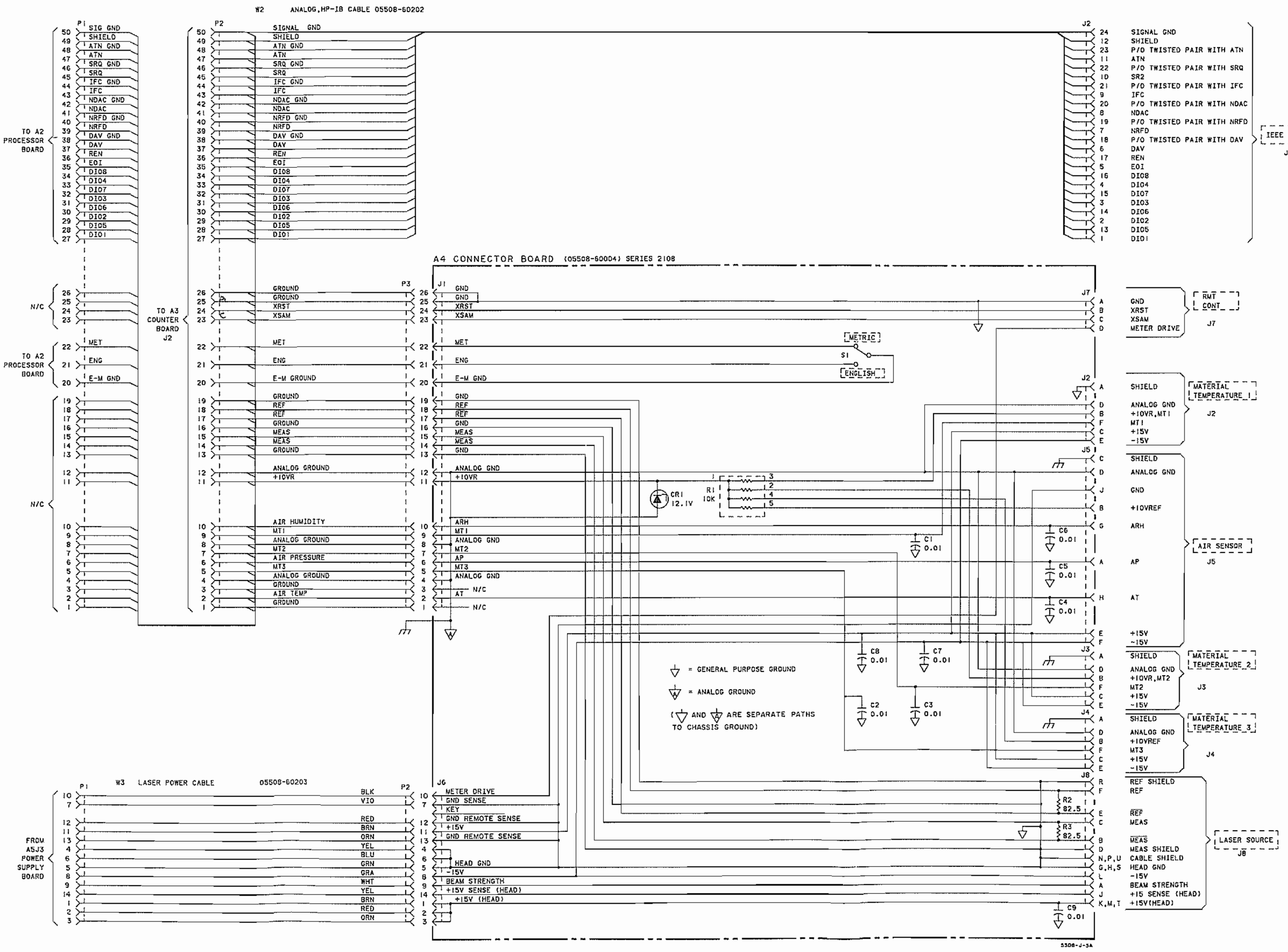
8-B-329. The board has two ground systems. Note that the inverted triangle with the A inside is used to denote "analog ground" on the schematic. The analog ground lines provide a means of replicating true ground (chassis) for U65, U67 and R5 on A3 and for the Air Sensors and Material Temperature Sensors without offset (IR drops). Thus these A/D conversions are referenced to the same ground level. Analog ground buffer U9, in the Air Sensor, provides an alternate path for ground current created in the Air Sensor in order to avoid IR drops on the analog ground within the Air Sensor cable. Other parts of the A4 are independently connected to chassis ground.

8-B-330. Several capacitors on A4 prevent emmission of EMI. R1 and CR1 protect the Voltage Reference. R2 and R3 terminate the twisted pairs that carry the Measurement and Reference signals from the Laser Head.

8-B-331. 5508A A4 CONNECTOR BOARD TROUBLESHOOTING

8-B-332. Use the schematic and an ohmmeter to check A4.


S1
J2
C1
23
24
J1
(ON OTHER SIDE)
CR1
R1
J3
1
2
C3
C2
J4
C5
C4
J5
15
J6
(ON OTHER SIDE)
C8
C7
C6
R2
R3


W2 ANALOG,HP-IB CABLE 05508-60202
P1
P2
J2
TO A2 PROCESSOR BOARD
TO A3 COUNTER BOARD J2
N/C
FROM A5J3 POWER SUPPLY BOARD
SIG GND
SHIELD
ATN GND
ATN
SRQ GND
SRQ
IFC GND
IFC
NDAC GND
NDAC
NRFD GND
NRFD
DAV GND
DAV
REN
EOI
DIO8
DIO4
DIO7
DIO3
DIO6
DIO2
DIO5
DIO1
SIGNAL GND
P/O TWISTED PAIR WITH ATN
P/O TWISTED PAIR WITH SRQ
SR2
P/O TWISTED PAIR WITH IFC
P/O TWISTED PAIR WITH NDAC
P/O TWISTED PAIR WITH NRFD
P/O TWISTED PAIR WITH DAV
IEEE STD 488 PORT
J9
A4 CONNECTOR BOARD (05508-60004) SERIES 2108
P3
J1
GROUND
XRST
XSAM
MET
ENG
E-M GROUND
E-M GND
REF
MEAS
ANALOG GROUND
+10VR
AIR HUMIDITY
MT1
MT2
AIR PRESSURE
MT3
AIR TEMP
ARH
AP
AT
N/C
J7
GND
METER DRIVE
RMT CONT
METRIC
S1
ENGLISH
MATERIAL TEMPERATURE 1
ANALOG GND
+10VR,MT1
+15V
-15V
CR1 12.1V
R1 10K
J5
+10VREF
AIR SENSOR
C1 0.01
C2 0.01
C3 0.01
C4 0.01
C5 0.01
C6 0.01
C7 0.01
C8 0.01
C9 0.01
J3
MATERIAL TEMPERATURE 2
+10VR,MT2
J4
MATERIAL TEMPERATURE 3
= GENERAL PURPOSE GROUND
= ANALOG GROUND
(AND ARE SEPARATE PATHS TO CHASSIS GROUND)
W3 LASER POWER CABLE 05508-60203
BLK
VIO
RED
BRN
ORN
YEL
BLU
GRN
GRA
WHT
J6
GND SENSE
KEY
GND REMOTE SENSE
HEAD GND
BEAM STRENGTH
+15V SENSE (HEAD)
+15V (HEAD)
J8
R2 82.5
R3 82.5
REF SHIELD
MEAS SHIELD
CABLE SHIELD
+15 SENSE (HEAD)
+15V(HEAD)
LASER SOURCE
N,P,U
G,H,S
K,M,T
5508-J-3A

NOTES:

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN FARADS; INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.

REFERENCE DESIGNATIONS
A4
C1-9 CR1 J1-8 R1-3 S1

Figure 8-B-22. 5508A A4 Rear Panel Connector Board 05508-60004

Figure 8-B-22
5508A A4 REAR PANEL CONNECTOR BOARD 05508-60004

(See Page 8-B-101)

8-B-333. 5508A A5 POWER SUPPLY BOARD CIRCUIT THEORY

8-B-334. Paragraphs 8-B-336 through 8-B-361 contain circuit theory for Power Supply Board A5. Paragraphs 8-B-362 through 8-B-364 cover the troubleshooting information.

8-B-335. The schematic diagram for Power Supply Board A5 is shown in Figure 8-B-32. The schematic has functional blocks that are labeled alphabetically with circled letters. These labels correspond to the circled letters in the text for the circuit theory.

8-B-336. The power supply provides the following outputs:

a. +15 volts at 3.15 amperes for use by the 5518A Laser Head. On the schematic, this is referred to as +15 VH, see Block G.

b. +5 volts at 4 amperes for use by 5508A boards A1, A2, and A3. On the schematic, this is referred to as +5 V REG, see Block F.

c. +15 volts at 150 milliamperes for use by circuits other than the laser head. On the schematic, this is referred to as +15 V, see Block H.

d. -15 volts at 150 milliamperes for the 5518A, 5508A, and the 10751A. On the schematic, this is referred to as -15 V, See Block E.

8-B-337. In addition, A5 contains a beam strength amplifier (Block B) to drive the meters in the front panel and the Remote Control Unit 05508-60021.

8-B-338. Primary Power Circuits Ⓐ

8-B-339. The primary power circuits consist of a three prong line connector J1, a power line module, on-off switch S1, thermal switch S2, blower motor B1, and the primary windings of T1.

8-B-340. The power line module contains a low pass filter and a line voltage selector card. The low pass filter, consisting of two inductors and two capacitors, prevents noise spikes and transients from entering the power supply. The line voltage selector card allows the instrument to operate off of four different line voltages, 100 V, 120 V, 220 V, and 240 V, as shown in Figure 8-B-32. Note that B1 always receives 120 volts regardless of the applied line voltage.

8-B-341. Thermal switch S2 monitors the temperature of the heat sink and opens the primary power line when the temperature exceeds 75 degrees centigrade.

8-B-342. In the secondaries of T1, the blue-brown sections develop 10 volts rms open circuit (9 volts rms full load) for the +5 V rectifier. The red-yellow sections develop 30 volts rms open circuit (23 volts rms full load) for the 15 volt supplies.

8-B-343. +5 Volt Power Supply Ⓘ and Ⓕ

8-B-344. The +5 volt supply consists of rectifier CR1 mounted on the heat sink, a 5 volt filter and fuse section, a 5 volt regulator, and a 5 volt series pass transistor.

8-B-345. The 5 volt regulator circuit consists of error amplifier A5U2 and series pass transistor Q1 mounted on the heat sink. Voltage reference A5U1 receives approximately +20 volts unregulated from block D and supplies a highly accurate and stable 10 volts to a voltage divider composed of A5R8 and A5R9. The divider develops 5.05 volts across A5R8 which is used as one input for error amplifier A5U2. The other input to A5U2 is fed back from the +5 volt remote sensing line. When A5U2 senses a change of output voltage, A5U2 drives series pass transistor Q1 to counteract the change and maintain the regulated voltage at the load.

8-B-346. Current limiting is performed by A5R5 and A5Q1. When the current through A5R5 approaches about 8 amperes, A5R5 drops 0.56 volt which is sufficient to turn on A5Q1. A5Q1 pulls the base voltage of Q1 toward the emitter voltage resulting in a reduction of the supply output voltage. In this manner, the output voltage decreases when necessary to prevent the load current from exceeding 8 amperes. Note, however, if the load current exceeds 5 amperes for more than 0.8 second, fuse F1 will blow. In other words, peak current is limited to 8 amperes while the load during a 0.8 second period is limited to 5 amperes.

8-B-347. Crowbar zener A5CR12 activates when the output voltage exceeds 6 volts and draws enough current to blow fuse F1. Typically, the zener will short when forced to blow the fuse.

8-B-348. A5DS1 indicates the presence of +5 volts. If +5 volt unreg fails (goes below 6.5 V), A5CR14 pulls A5U2 pin 3 low to prevent the +20 volt unreg from feeding through A5U1, A5U2, and Q1.

8-B-349. Remote sensing is accomplished by returning a line from the load back to J1-26. A5R2 feeds back the sensed load voltage (+5 V less line drop) to the minus input of A5U2. The regulator circuit attempts to keep the two inputs of A5U2 the same, thus compensating for IR drop across cable W1.

8-B-350. If there is no voltage on the remote sense line (cable W1 is unplugged), the output tries to rise to 10 volts. A5CR1 and A5C5 clamp A5U2 pin 2 at a minimum of one diode drop below the output at A5R5 resulting in a maximum output of 5.7 volts. This also determines the maximum line loss that the regulator can compensate for (0.7 V).

8-B-351. +15 Volt Head Power Supply Ⓖ

8-B-352. The +15 Volt Power Supply is similar to the +5 Volt supply so only the differences will be described. The reference input to the error amplifier A5U5 is the 10 volt reference supplied through A5R13. To achieve the required +15 volt output, the feedback voltage to the minus input of A5U5 is multiplied by 2/3 by voltage divider R30 and R33. Thus for 15 volts at the output, the voltage at the junction of A5R30 and A5R33 is 10 volts. A5U5 attempts to keep the voltage at A5U5' pin 2 at 10 volts, thereby maintaining the output at the required 15 volts.

8-B-353. A5R34 allows the output voltage to change up to 1 V to compensate for line loss in the head cable. Another change is A5R13 which serves the same function as CR14 in the +5 volt supply. If the +20 volt unreg fails, which would give a false "on" indication, A5R13 prevents any significant amount of current from flowing through A5Q2 into A5DS3.

8-B-354. Another difference is A5CR8 and A5R31. The zener diode adds 7.15 volts to the output of A5U5 to allow the output to rise sufficiently (19 V) to control Q2 (mounted on the heat sink). A5R31 provides current to keep the zener in conduction.

8-B-355. The remote sense line for the +15 volt supply connects to J3-14. If the head is disconnected, the output rises to 15.6 volts.

8-B-356. ±15 Volt Regulators Ⓗ and Ⓔ

8-B-357. The low current + and -15 volt power supplies (Blocks H and E) have relatively clean outputs since they are independent of the large current variations induced by the laser head. Both supplies provide power to the Air Sensor, the Material Temperature Sensors, and circuits in the 5508A. The -15 volt supply also provides low level current to the 5518A Laser Head.

8-B-358. The regulators are three terminal devices. If the input is lost, A5CR3 and A5CR10 prevent the output filter capacitor from discharging through and destroying the regulators. A5CR2 and A5CR11 protect the regulators if the wrong polarity is applied at the output.

8-B-359. Beam Strength Amplifier Ⓑ

8-B-360. In the laser head, receiver board A2 provides a current source whose output is proportional to the strength of the return measurement beam. With no return beam, the current source switches off. For maximum return beam, the current source output is (-) 2 milliamperes. The equivalent circuit is shown in Figure 8-B-23.

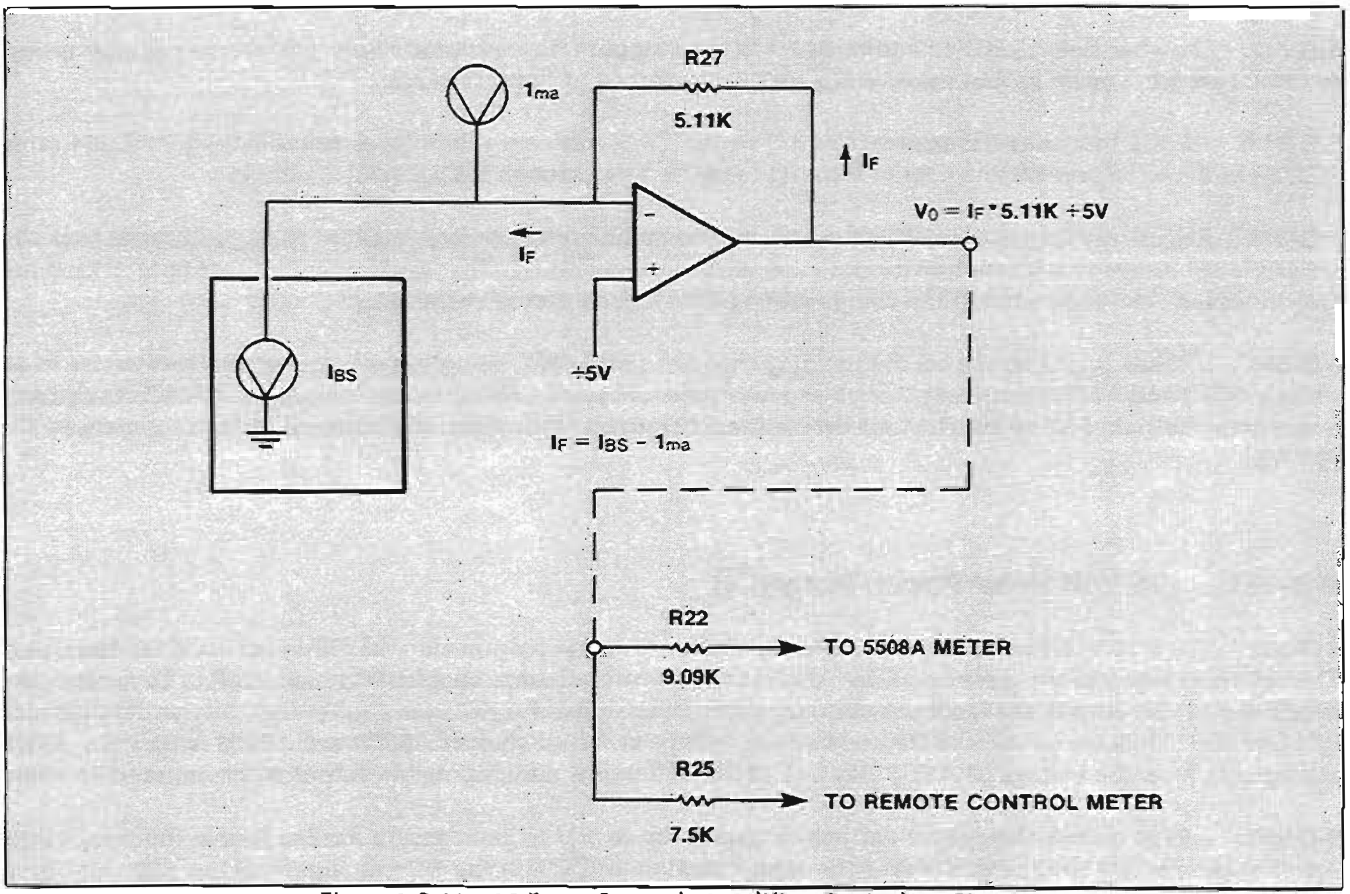


Figure 8-B-23. A5 Beam Strength Amplifier, Equivalent Circuit

8-B-361. The 5508A beam strength meter, as well as the meter in the optional remote control unit, requires 1 milliampere for full scale deflection. Resistance is added in series with both meters to make a total resistance of 10k ohms in each path. This results in an output of 10 volts causing full scale deflection in one or both meters. Figure 8-B-23 illustrates the three functions of the beam strength amplifier: provide an offset current of 1 milliampere, current to voltage conversion, and capability to drive 2 meters simultaneously. In addition A5CR6 and A5CR7 provide over voltage protection and A5R24 and A5C12 provide high frequency rejection.

8-B-362. 5508A A5 POWER SUPPLY BOARD TROUBLESHOOTING

8-B-363. Before troubleshooting the power supplies, use the 5518A as a load by connectng it to the 5508A. Set the voltage selector card in the 5508A for 115/120 V operation. Measure the power supply voltages in Table 8-B-12 (-15 V, +15 V, +15 VH, and +5 V) and refer to the Power Supply Troubleshooting Table 8-B-13 to determine which procedure to follow. If more than one supply is faulty, the sections should be repaired in the following order.

-15 V

+15 V

+15 VH

+5 V

8-B-364. After repairing a supply, measure the power supply voltages again and use the new symptoms to identify the proper procedure to follow in the Power Supply Troubleshooting Table 8-B-13. A power supply voltage is considered incorrect if it does not meet specifications. Table 8-B-12 lists the voltage specifications for the power supplies.

Table 8-B-12. Power Supply Voltage Specifications

Supply Voltage	Acceptable Range
-15 V	-14.4 to -15.6 V
+15 V	+14.7 to +15.3 V
+15 VH	+14.7 to +15.3 V*
+5 V	+4.96 to +5.16 V*

**If the remote sense line is open or grounded, the output voltage will exceed the specification by 0.3 or -0.6 volt.*

Table 8-B-13. Power Supply Troubleshooting

Symptom	Action
All output voltages incorrect	See Figure 8-B-24
-15 V output incorrect	See Figure 8-B-26
+15 V output incorrect but -15 V output OK	See Figure 8-B-27
+15 VH output incorrect but -15 V & +15 V OK	See Figure 8-B-28
+15 VH fuse (F2) blows	See Figure 8-B-29
+5 V output incorrect but all other voltages OK	See Figure 8-B-30
+5 V fuse (F1) blows	See Figure 8-B-31

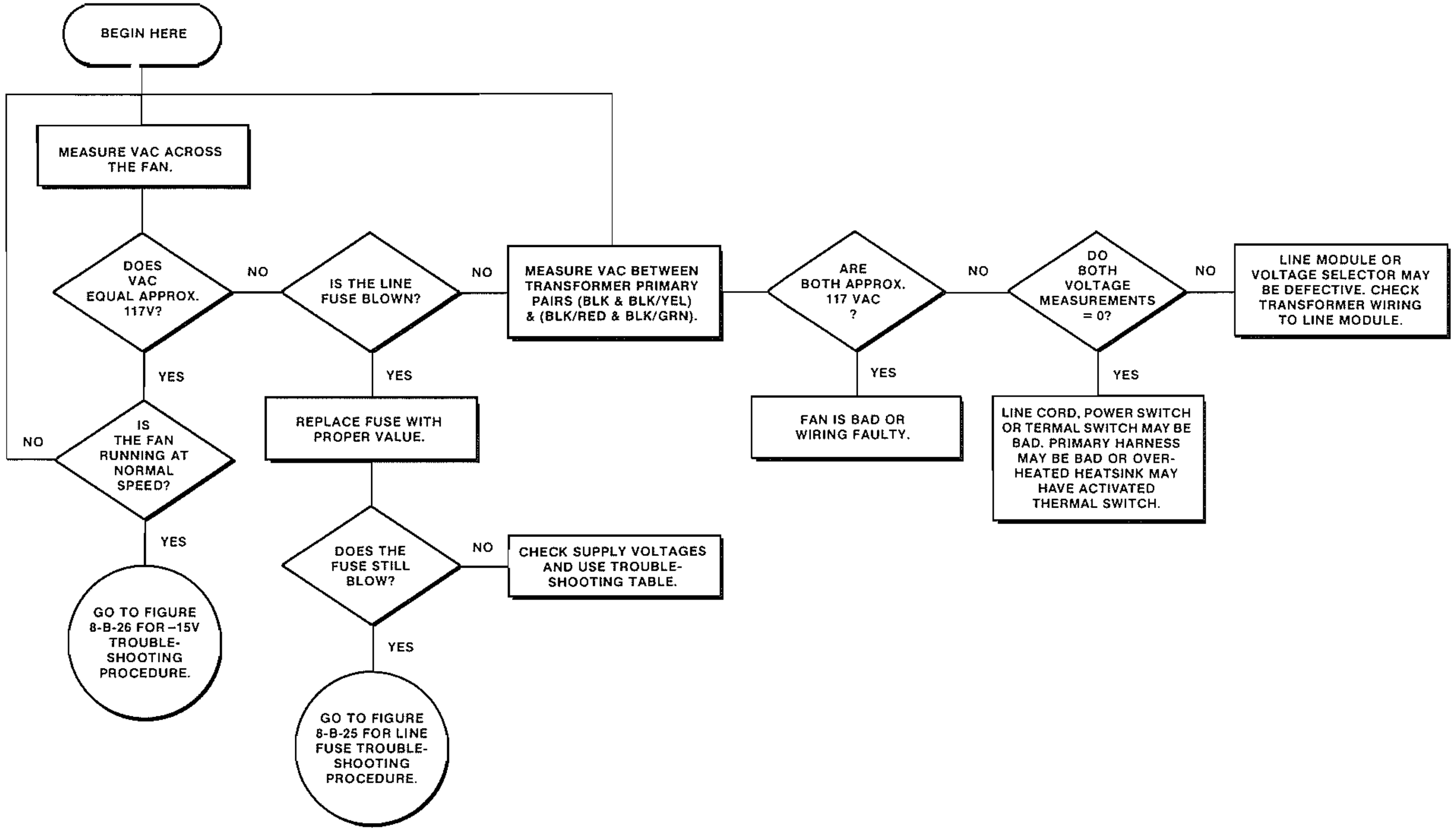

BEGIN HERE
MEASURE VAC ACROSS THE FAN.
DOES VAC EQUAL APPROX. 117V?
NO
IS THE LINE FUSE BLOWN?
NO
MEASURE VAC BETWEEN TRANSFORMER PRIMARY PAIRS (BLK & BLK/YEL) & (BLK/RED & BLK/GRN).
ARE BOTH APPROX. 117 VAC ?
NO
DO BOTH VOLTAGE MEASUREMENTS = 0?
NO
LINE MODULE OR VOLTAGE SELECTOR MAY BE DEFECTIVE. CHECK TRANSFORMER WIRING TO LINE MODULE.
YES
IS THE FAN RUNNING AT NORMAL SPEED?
NO
YES
GO TO FIGURE 8-B-26 FOR −15V TROUBLE-SHOOTING PROCEDURE.
YES
REPLACE FUSE WITH PROPER VALUE.
DOES THE FUSE STILL BLOW?
NO
CHECK SUPPLY VOLTAGES AND USE TROUBLE-SHOOTING TABLE.
YES
GO TO FIGURE 8-B-25 FOR LINE FUSE TROUBLE-SHOOTING PROCEDURE.
YES
FAN IS BAD OR WIRING FAULTY.
YES
LINE CORD, POWER SWITCH OR TERMAL SWITCH MAY BE BAD. PRIMARY HARNESS MAY BE BAD OR OVER-HEATED HEATSINK MAY HAVE ACTIVATED THERMAL SWITCH.

Figure 8-B-24. Troubleshooting Procedure for All Supply Voltages Incorrect

Figure 8-B-24

TROUBLESHOOTING PROCEDURE FOR ALL SUPPLY VOLTAGES INCORRECT

(See Page 8-B-107)

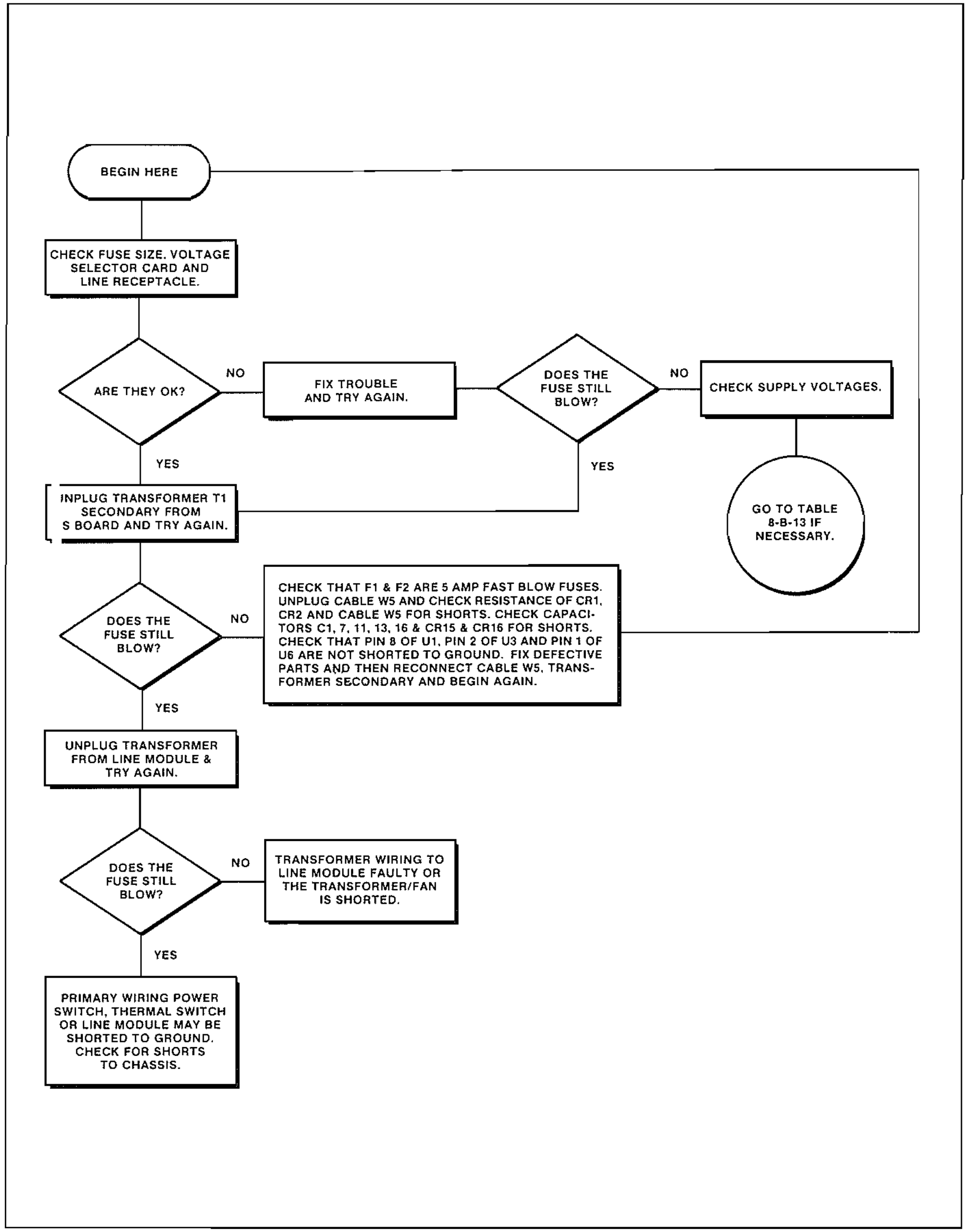

BEGIN HERE
CHECK FUSE SIZE. VOLTAGE SELECTOR CARD AND LINE RECEPTACLE.
ARE THEY OK?
NO
FIX TROUBLE AND TRY AGAIN.
DOES THE FUSE STILL BLOW?
NO
CHECK SUPPLY VOLTAGES.
GO TO TABLE 8-B-13 IF NECESSARY.
YES
YES
INPLUG TRANSFORMER T1 SECONDARY FROM S BOARD AND TRY AGAIN.
DOES THE FUSE STILL BLOW?
NO
CHECK THAT F1 & F2 ARE 5 AMP FAST BLOW FUSES. UNPLUG CABLE W5 AND CHECK RESISTANCE OF CR1, CR2 AND CABLE W5 FOR SHORTS. CHECK CAPACITORS C1, 7, 11, 13, 16 & CR15 & CR16 FOR SHORTS. CHECK THAT PIN 8 OF U1, PIN 2 OF U3 AND PIN 1 OF U6 ARE NOT SHORTED TO GROUND. FIX DEFECTIVE PARTS AND THEN RECONNECT CABLE W5, TRANSFORMER SECONDARY AND BEGIN AGAIN.
YES
UNPLUG TRANSFORMER FROM LINE MODULE & TRY AGAIN.
DOES THE FUSE STILL BLOW?
NO
TRANSFORMER WIRING TO LINE MODULE FAULTY OR THE TRANSFORMER/FAN IS SHORTED.
YES
PRIMARY WIRING POWER SWITCH, THERMAL SWITCH OR LINE MODULE MAY BE SHORTED TO GROUND. CHECK FOR SHORTS TO CHASSIS.

Figure 8-B-25. Troubleshooting Procedure for Blown Line Fuse

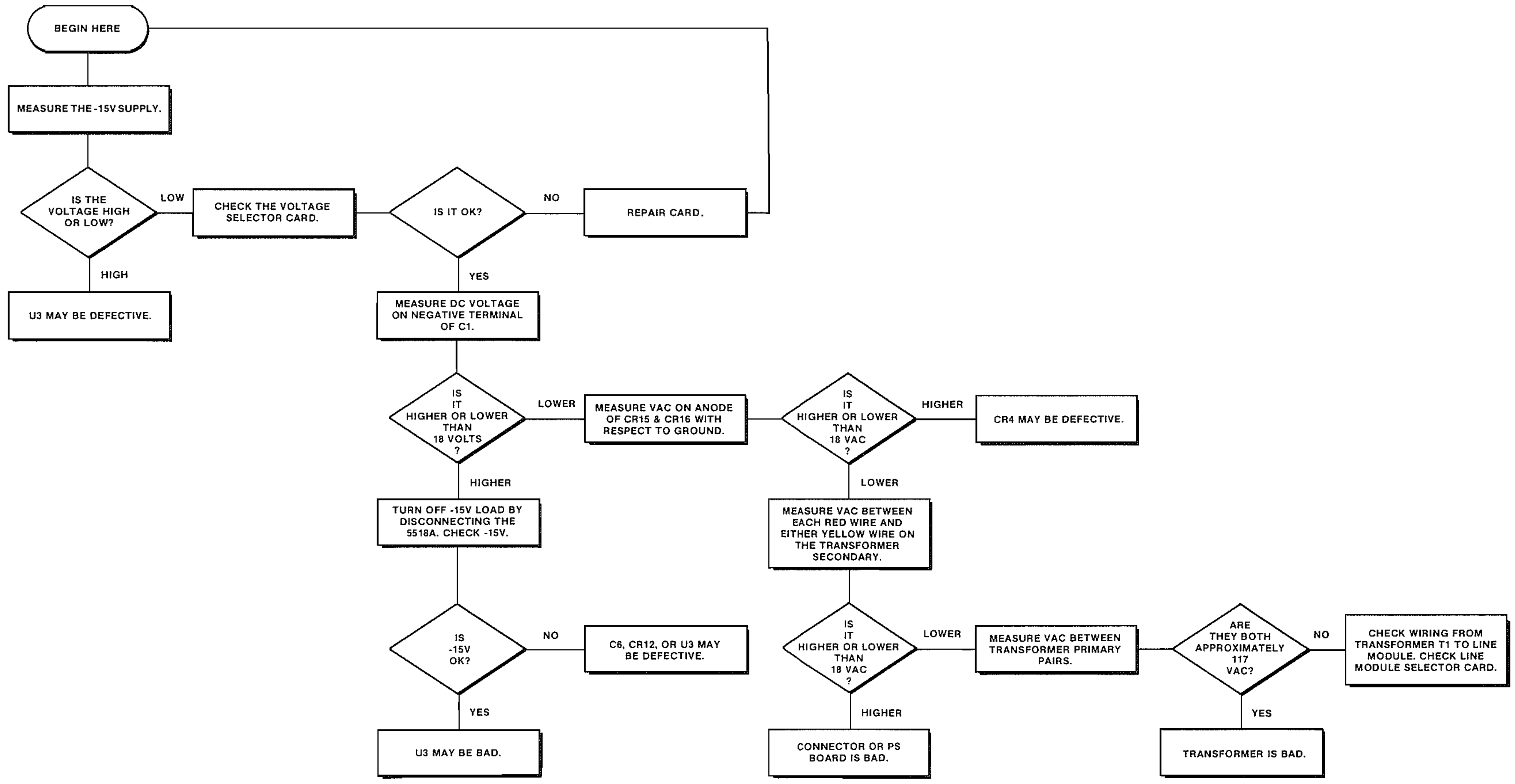

BEGIN HERE
MEASURE THE -15V SUPPLY.
IS THE VOLTAGE HIGH OR LOW?
LOW
HIGH
U3 MAY BE DEFECTIVE.
CHECK THE VOLTAGE SELECTOR CARD.
IS IT OK?
NO
REPAIR CARD.
YES
MEASURE DC VOLTAGE ON NEGATIVE TERMINAL OF C1.
IS IT HIGHER OR LOWER THAN 18 VOLTS ?
LOWER
MEASURE VAC ON ANODE OF CR15 & CR16 WITH RESPECT TO GROUND.
IS IT HIGHER OR LOWER THAN 18 VAC ?
HIGHER
CR4 MAY BE DEFECTIVE.
LOWER
MEASURE VAC BETWEEN EACH RED WIRE AND EITHER YELLOW WIRE ON THE TRANSFORMER SECONDARY.
IS IT HIGHER OR LOWER THAN 18 VAC ?
LOWER
MEASURE VAC BETWEEN TRANSFORMER PRIMARY PAIRS.
ARE THEY BOTH APPROXIMATELY 117 VAC?
NO
CHECK WIRING FROM TRANSFORMER T1 TO LINE MODULE. CHECK LINE MODULE SELECTOR CARD.
YES
TRANSFORMER IS BAD.
HIGHER
CONNECTOR OR PS BOARD IS BAD.
HIGHER
TURN OFF -15V LOAD BY DISCONNECTING THE 5518A. CHECK -15V.
IS -15V OK?
NO
C6, CR12, OR U3 MAY BE DEFECTIVE.
YES
U3 MAY BE BAD.

Figure 8-B-26. -15 V Power Supply Troubleshooting Procedure

Figure 8-B-26

-15V POWER SUPPLY TROUBLESHOOTING PROCEDURE

(See Page 8-B-109)

NOTE

This procedure assumes that the -15V supply is functioning properly, thereby ensuring that the entire transformer primary and the red secondary are OK.

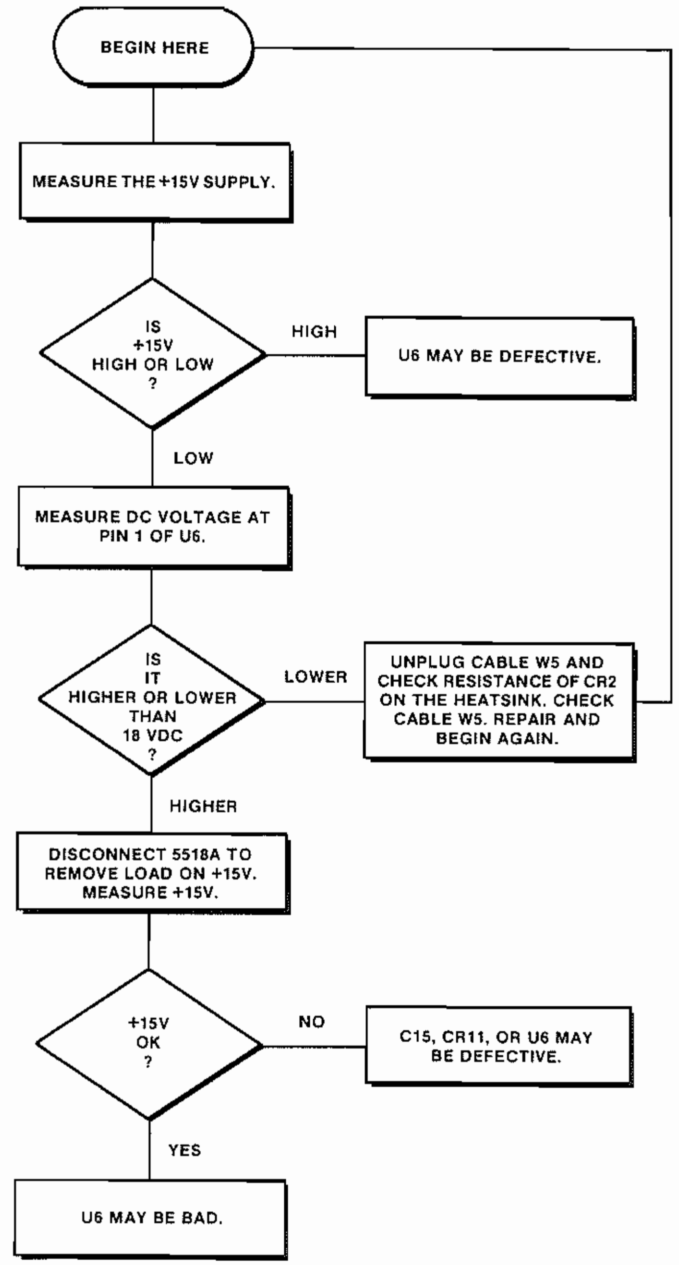
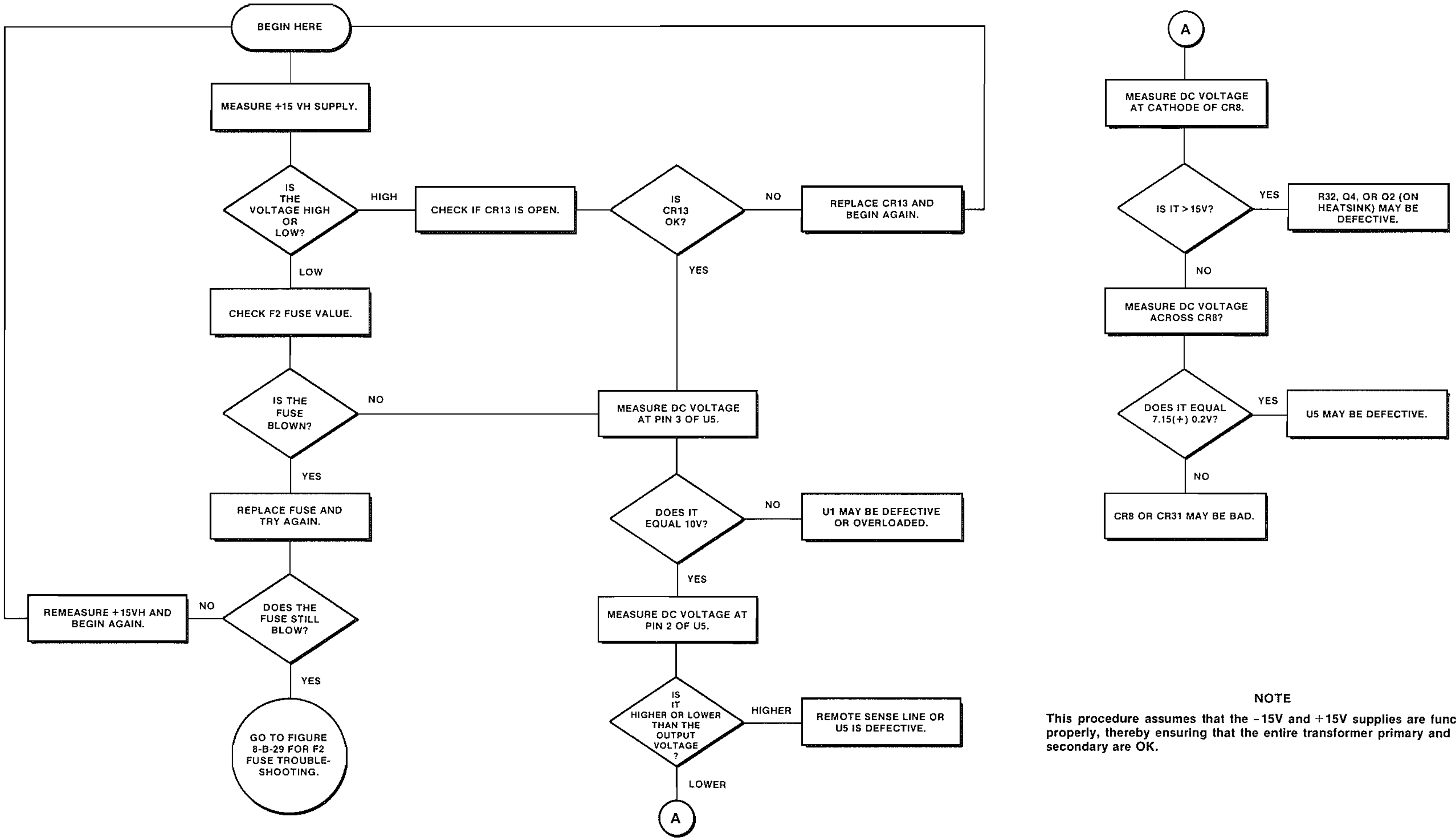

BEGIN HERE
MEASURE THE +15V SUPPLY.
IS +15V HIGH OR LOW ?
HIGH
U6 MAY BE DEFECTIVE.
LOW
MEASURE DC VOLTAGE AT PIN 1 OF U6.
IS IT HIGHER OR LOWER THAN 18 VDC ?
LOWER
UNPLUG CABLE W5 AND CHECK RESISTANCE OF CR2 ON THE HEATSINK. CHECK CABLE W5. REPAIR AND BEGIN AGAIN.
HIGHER
DISCONNECT 5518A TO REMOVE LOAD ON +15V. MEASURE +15V.
+15V OK ?
NO
C15, CR11, OR U6 MAY BE DEFECTIVE.
YES
U6 MAY BE BAD.

Figure 8-B-27. +15 V Power Supply Troubleshooting Procedure


BEGIN HERE
MEASURE +15 VH SUPPLY.
IS THE VOLTAGE HIGH OR LOW?
HIGH
CHECK IF CR13 IS OPEN.
IS CR13 OK?
NO
REPLACE CR13 AND BEGIN AGAIN.
YES
LOW
CHECK F2 FUSE VALUE.
IS THE FUSE BLOWN?
NO
MEASURE DC VOLTAGE AT PIN 3 OF U5.
YES
REPLACE FUSE AND TRY AGAIN.
DOES IT EQUAL 10V?
NO
U1 MAY BE DEFECTIVE OR OVERLOADED.
YES
MEASURE DC VOLTAGE AT PIN 2 OF U5.
REMEASURE +15VH AND BEGIN AGAIN.
NO
DOES THE FUSE STILL BLOW?
YES
GO TO FIGURE 8-B-29 FOR F2 FUSE TROUBLE-SHOOTING.
IS IT HIGHER OR LOWER THAN THE OUTPUT VOLTAGE ?
HIGHER
REMOTE SENSE LINE OR U5 IS DEFECTIVE.
LOWER
A
A
MEASURE DC VOLTAGE AT CATHODE OF CR8.
IS IT > 15V?
YES
R32, Q4, OR Q2 (ON HEATSINK) MAY BE DEFECTIVE.
NO
MEASURE DC VOLTAGE ACROSS CR8?
DOES IT EQUAL 7.15(+) 0.2V?
YES
U5 MAY BE DEFECTIVE.
NO
CR8 OR CR31 MAY BE BAD.

NOTE

This procedure assumes that the -15V and +15V supplies are functioning properly, thereby ensuring that the entire transformer primary and the red secondary are OK.

Figure 8-B-28. +15 VH Power Supply Troubleshooting Procedure

Figure 8-B-28
+15 VH POWER SUPPLY TROUBLESHOOTING PROCEDURE

(See Page 8-B-111)

NOTE

This procedure assumes that both the -15V and +15V supplies are functioning properly, thereby ensuring that the entire transformer primary and the red secondary are OK.

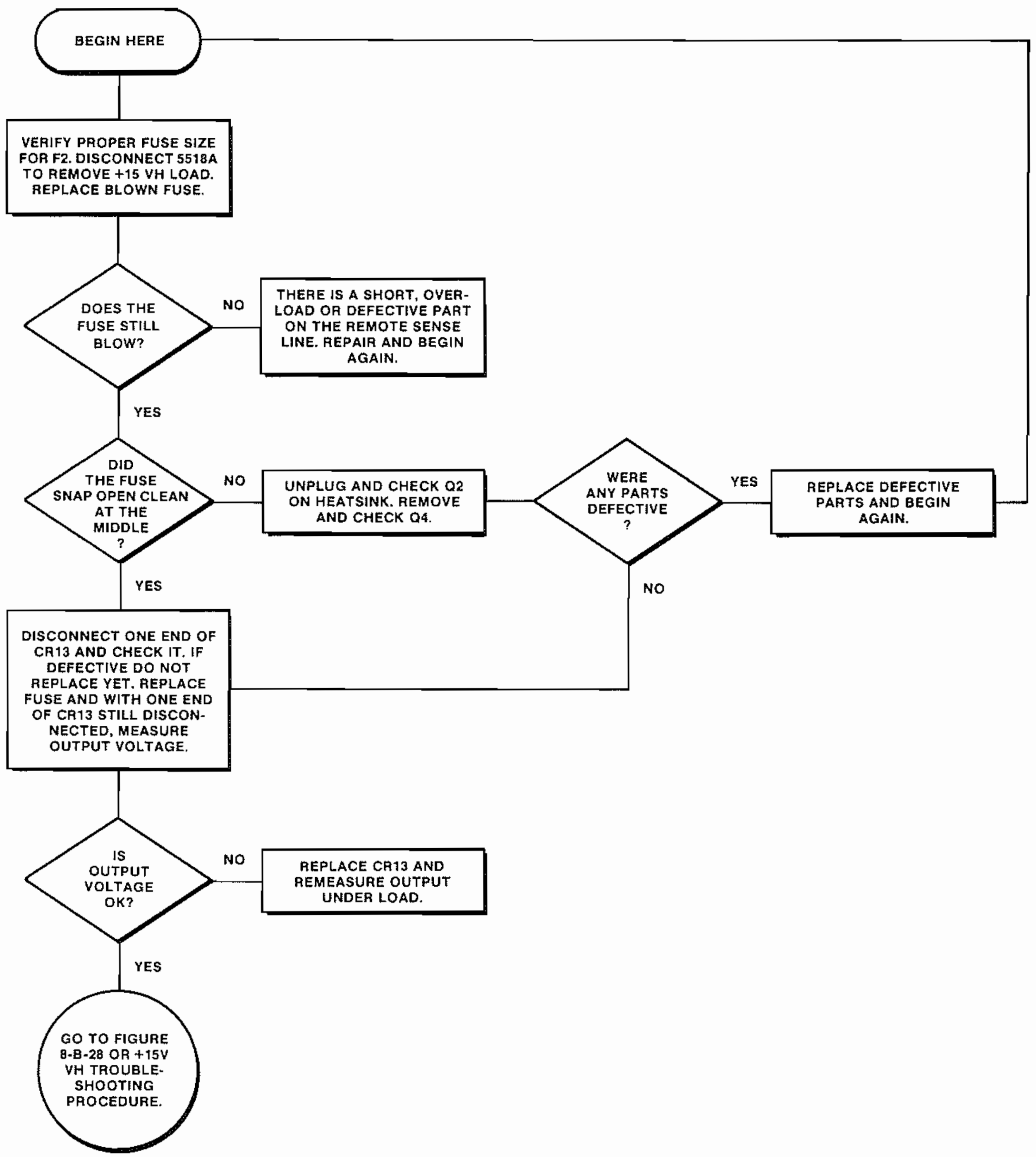

BEGIN HERE
VERIFY PROPER FUSE SIZE FOR F2. DISCONNECT 5518A TO REMOVE +15 VH LOAD. REPLACE BLOWN FUSE.
DOES THE FUSE STILL BLOW?
NO
THERE IS A SHORT, OVERLOAD OR DEFECTIVE PART ON THE REMOTE SENSE LINE. REPAIR AND BEGIN AGAIN.
YES
DID THE FUSE SNAP OPEN CLEAN AT THE MIDDLE ?
NO
UNPLUG AND CHECK Q2 ON HEATSINK. REMOVE AND CHECK Q4.
WERE ANY PARTS DEFECTIVE ?
YES
REPLACE DEFECTIVE PARTS AND BEGIN AGAIN.
NO
YES
DISCONNECT ONE END OF CR13 AND CHECK IT. IF DEFECTIVE DO NOT REPLACE YET. REPLACE FUSE AND WITH ONE END OF CR13 STILL DISCONNECTED, MEASURE OUTPUT VOLTAGE.
IS OUTPUT VOLTAGE OK?
NO
REPLACE CR13 AND REMEASURE OUTPUT UNDER LOAD.
YES
GO TO FIGURE 8-B-28 OR +15V VH TROUBLESHOOTING PROCEDURE.

Figure 8-B-29. +15 VH Blown Fuse Troubleshooting Procedure

NOTE

This procedure assumes that all supply voltages are functioning properly except the +15V, thereby ensuring that the entire transformer primary and red secondary are OK.

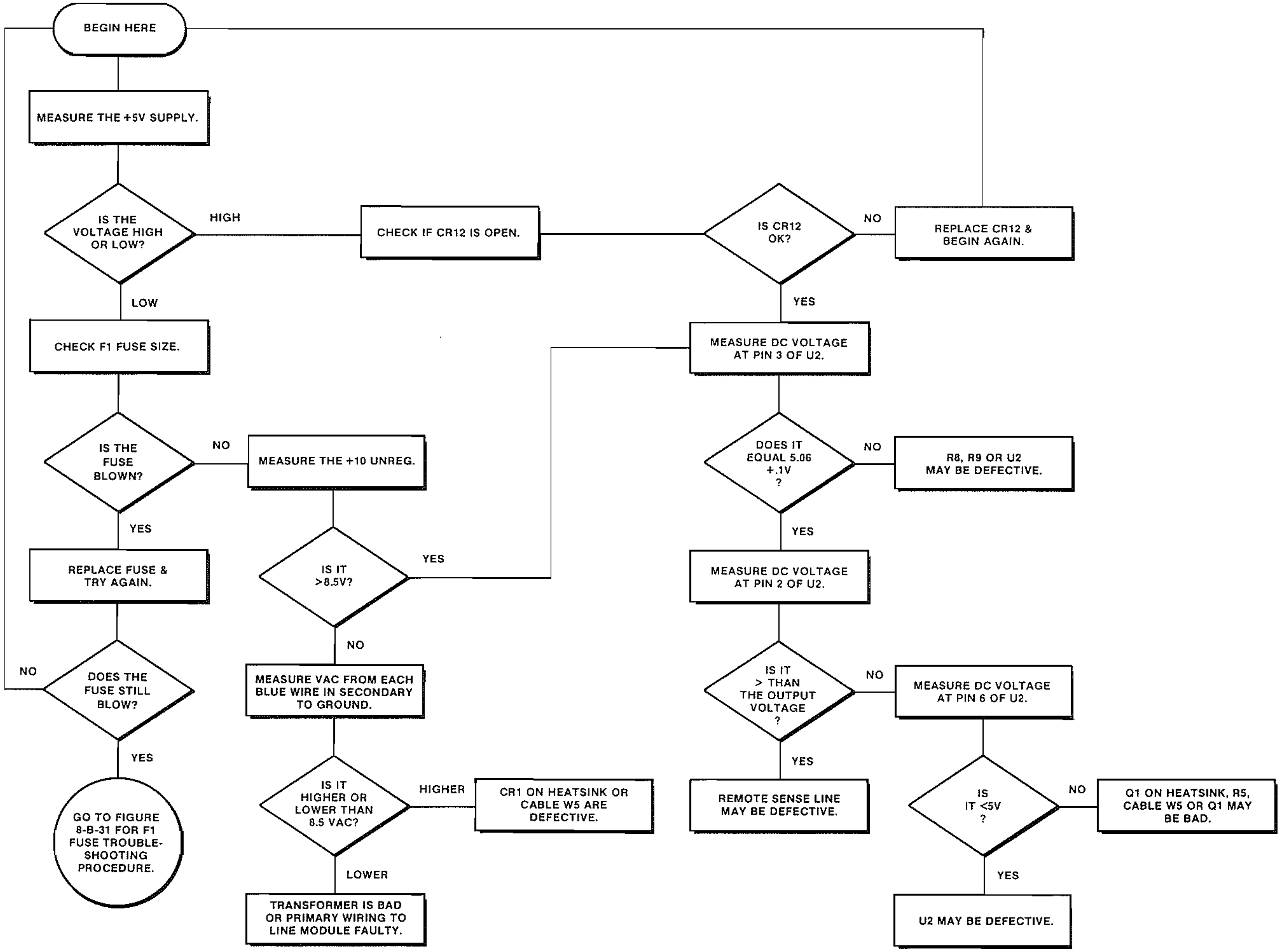

BEGIN HERE
MEASURE THE +5V SUPPLY.
IS THE VOLTAGE HIGH OR LOW?
HIGH
CHECK IF CR12 IS OPEN.
IS CR12 OK?
NO
REPLACE CR12 & BEGIN AGAIN.
YES
LOW
CHECK F1 FUSE SIZE.
MEASURE DC VOLTAGE AT PIN 3 OF U2.
IS THE FUSE BLOWN?
NO
MEASURE THE +10 UNREG.
DOES IT EQUAL 5.06 +.1V ?
NO
R8, R9 OR U2 MAY BE DEFECTIVE.
YES
REPLACE FUSE & TRY AGAIN.
IS IT >8.5V?
YES
YES
MEASURE DC VOLTAGE AT PIN 2 OF U2.
NO
DOES THE FUSE STILL BLOW?
NO
MEASURE VAC FROM EACH BLUE WIRE IN SECONDARY TO GROUND.
IS IT > THAN THE OUTPUT VOLTAGE ?
NO
MEASURE DC VOLTAGE AT PIN 6 OF U2.
YES
YES
GO TO FIGURE 8-B-31 FOR F1 FUSE TROUBLE-SHOOTING PROCEDURE.
IS IT HIGHER OR LOWER THAN 8.5 VAC?
HIGHER
CR1 ON HEATSINK OR CABLE W5 ARE DEFECTIVE.
REMOTE SENSE LINE MAY BE DEFECTIVE.
IS IT <5V ?
NO
Q1 ON HEATSINK, R5, CABLE W5 OR Q1 MAY BE BAD.
LOWER
TRANSFORMER IS BAD OR PRIMARY WIRING TO LINE MODULE FAULTY.
YES
U2 MAY BE DEFECTIVE.

Figure 8-B-30. +5 V Power Supply Troubleshooting Procedure

Figure 8-B-30
+5V POWER SUPPLY TROUBLESHOOTING PROCEDURE

(See Page 8-B-113)

NOTE

This procedure assumes that all power supply voltages are functioning properly except the +5V, thereby ensuring that the entire transformer primary and red secondary are OK.

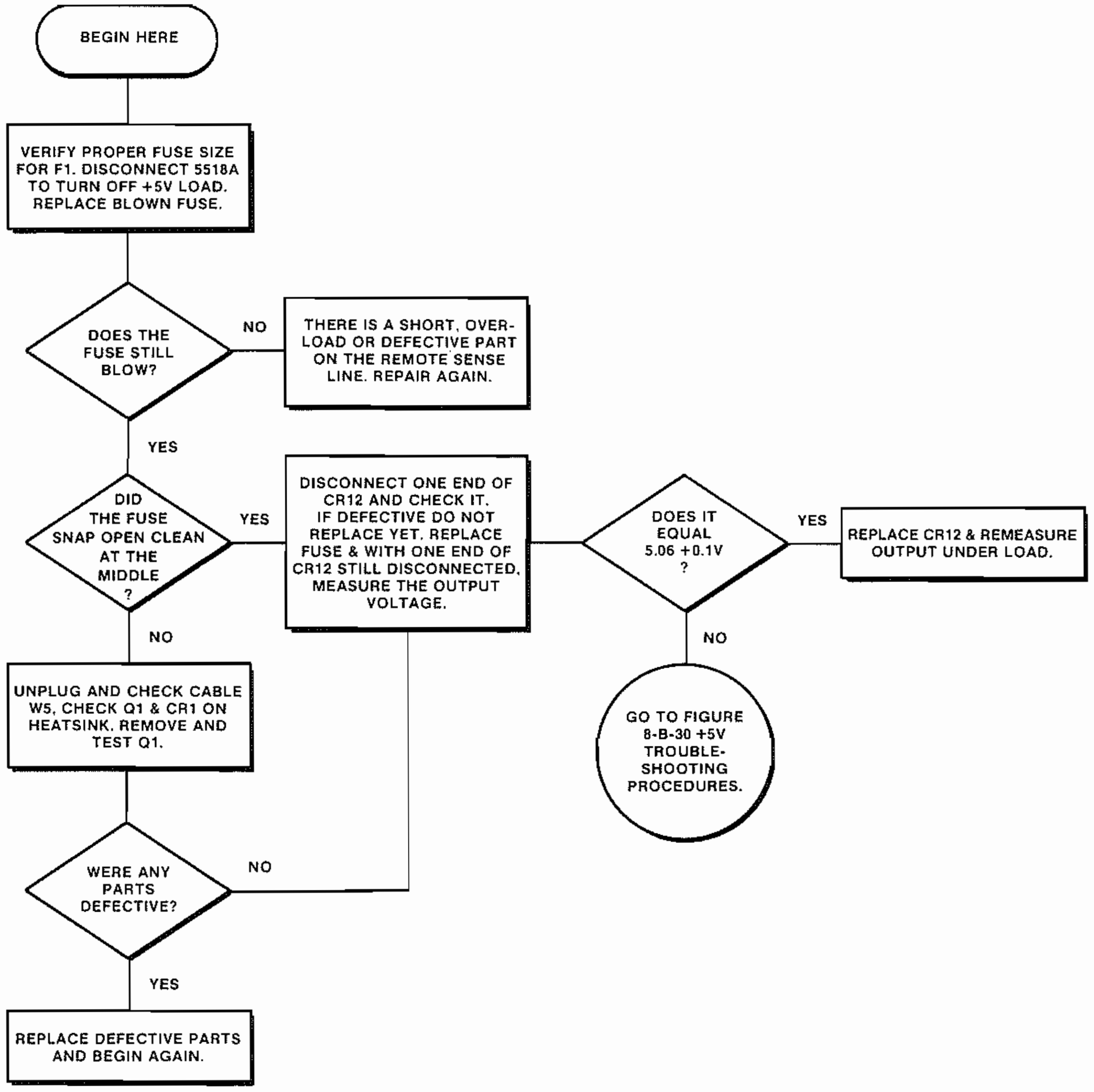
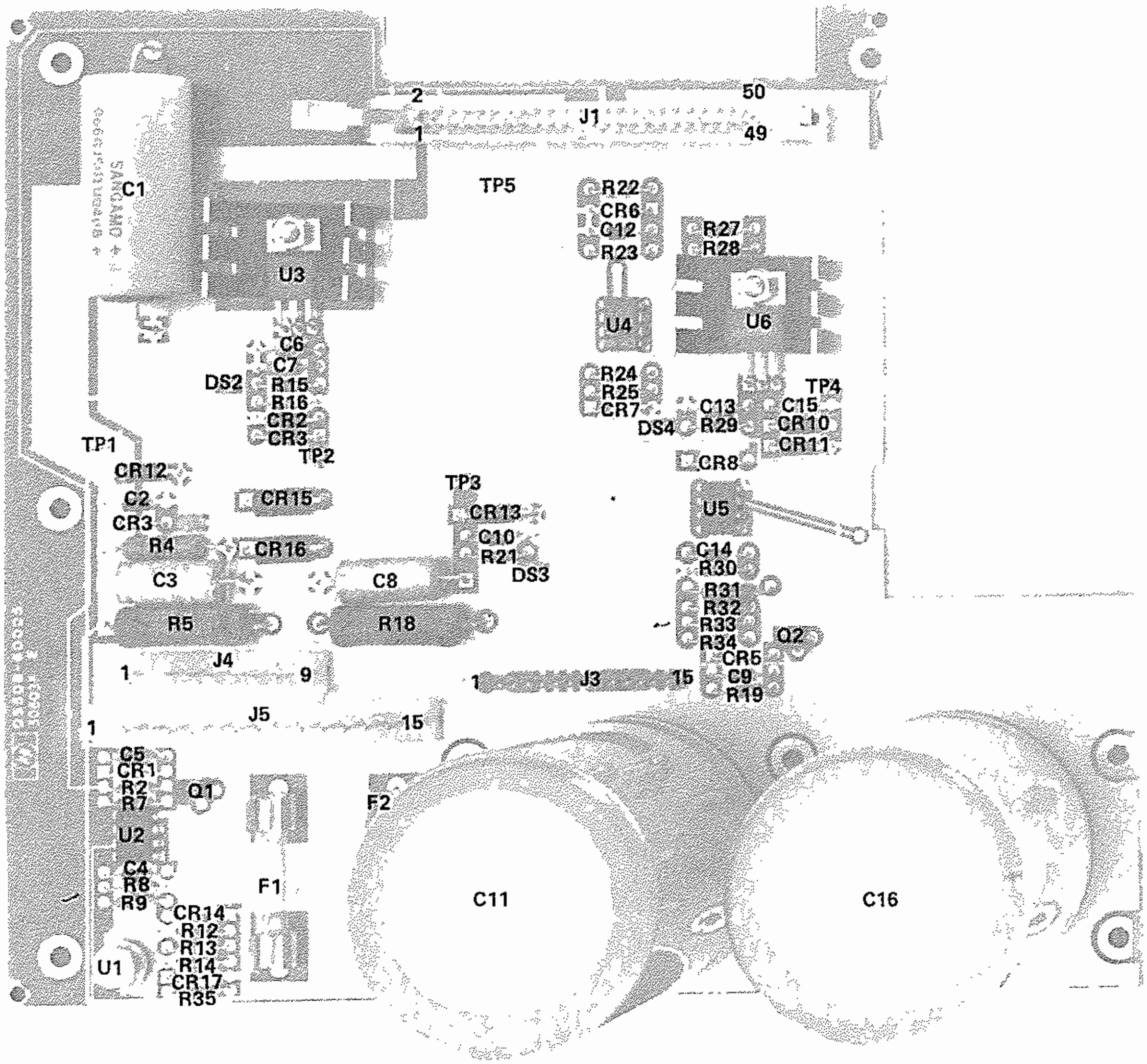
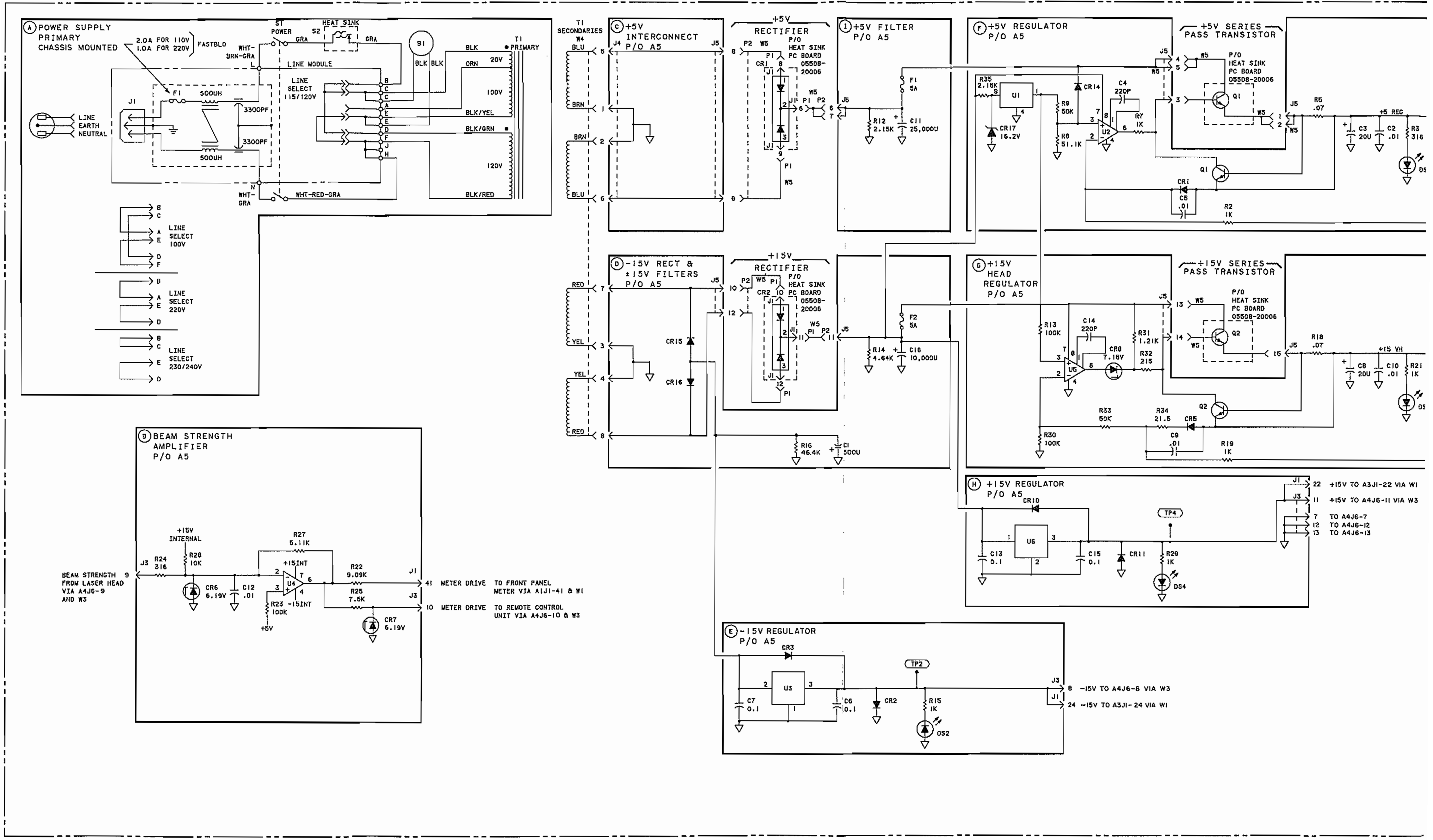

BEGIN HERE
VERIFY PROPER FUSE SIZE FOR F1. DISCONNECT 5518A TO TURN OFF +5V LOAD. REPLACE BLOWN FUSE.
DOES THE FUSE STILL BLOW?
NO
THERE IS A SHORT, OVERLOAD OR DEFECTIVE PART ON THE REMOTE SENSE LINE. REPAIR AGAIN.
YES
DID THE FUSE SNAP OPEN CLEAN AT THE MIDDLE ?
YES
DISCONNECT ONE END OF CR12 AND CHECK IT. IF DEFECTIVE DO NOT REPLACE YET. REPLACE FUSE & WITH ONE END OF CR12 STILL DISCONNECTED, MEASURE THE OUTPUT VOLTAGE.
DOES IT EQUAL 5.06 +0.1V ?
YES
REPLACE CR12 & REMEASURE OUTPUT UNDER LOAD.
NO
GO TO FIGURE 8-B-30 +5V TROUBLESHOOTING PROCEDURES.
NO
UNPLUG AND CHECK CABLE W5, CHECK Q1 & CR1 ON HEATSINK. REMOVE AND TEST Q1.
WERE ANY PARTS DEFECTIVE?
NO
YES
REPLACE DEFECTIVE PARTS AND BEGIN AGAIN.

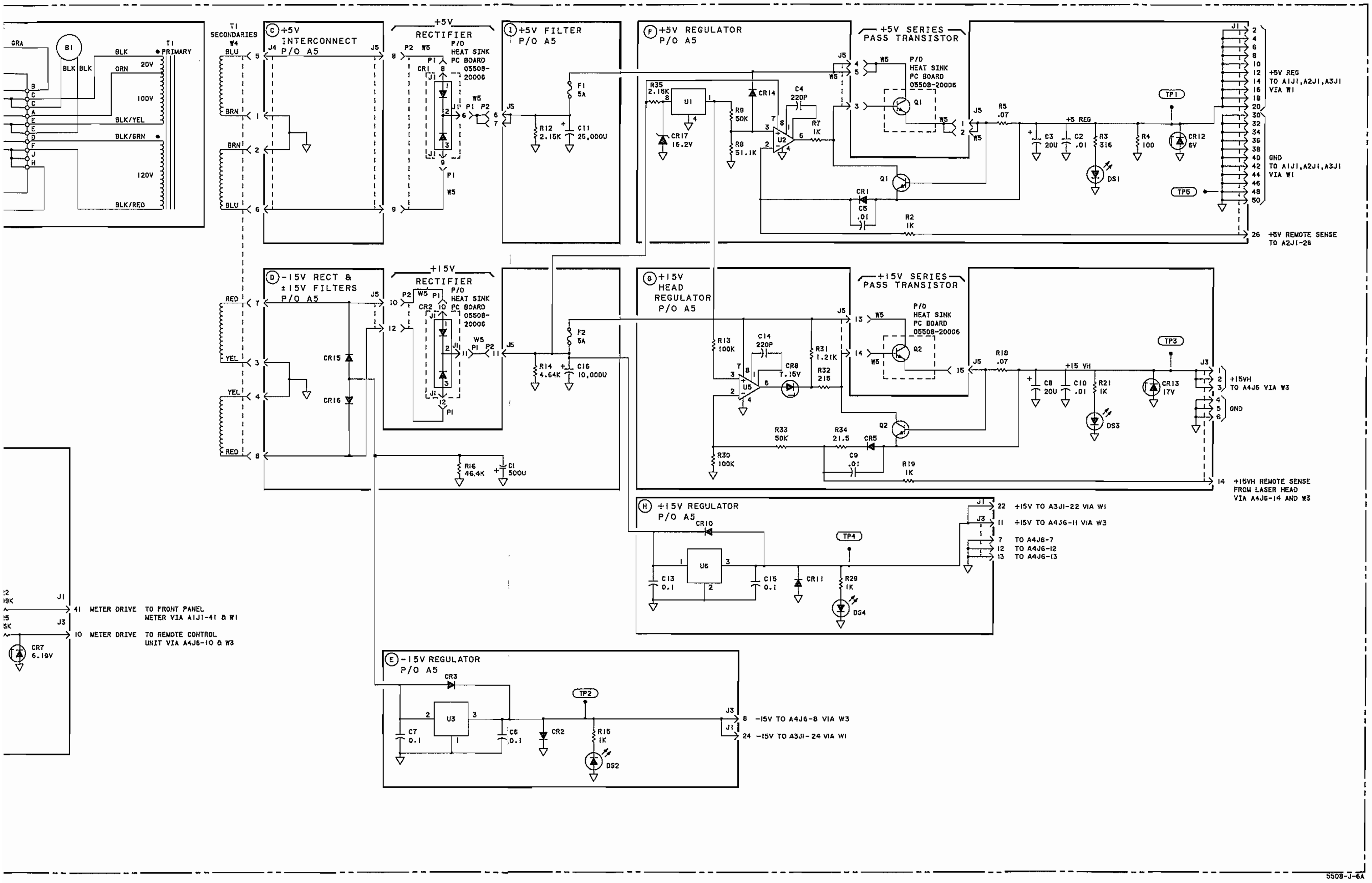
Figure 8-B-31. Troubleshooting Procedure for F1 (+5 V) Fuse Blows


2
50
J1
1
49
C1
TP5
R22
CR6
C12
R23
R27
R28
U3
U4
U6
C6
C7
DS2
R15
R16
CR2
CR3
TP2
R24
R25
CR7
C13
C15
TP4
R29
CR10
DS4
CR11
CR8
TP1
CR12
C2
CR15
TP3
CR13
U5
CR3
C10
R4
CR16
R21
DS3
C14
R30
C3
C8
R31
R32
R5
R18
R33
R34
Q2
CR5
1
J4
9
1
J3
15
C9
R19
1
J5
15
C5
CR1
R2
R7
Q1
F2
U2
C4
R8
F1
R9
C11
C16
CR14
R12
R13
R14
U1
CR17
R35

A5 POWER SUPPLY BD 05508-60005 SERIES 2626



Ⓐ POWER SUPPLY PRIMARY CHASSIS MOUNTED
2.0A FOR 110V
1.0A FOR 220V
FASTBLO
S1 POWER
S2
HEAT SINK
GRA
B1
BLK
T1 PRIMARY
WHT-BRN-GRA
L
LINE MODULE
LINE SELECT 115/120V
F1
500UH
3300PF
J1
LINE
EARTH
NEUTRAL
20V
100V
120V
BLK/YEL
BLK/GRN
BLK/RED
GRN
N
WHT-GRA
WHT-RED-GRA
LINE SELECT 100V
LINE SELECT 220V
LINE SELECT 230/240V
T1 SECONDARIES
W4
BLU
BRN
RED
YEL
Ⓒ +5V INTERCONNECT P/O A5
J4
J5
+5V RECTIFIER
P/O HEAT SINK PC BOARD 05508-20006
P2
W5
P1
CR1
J1
Ⓘ +5V FILTER P/O A5
F1 5A
R12 2.15K
C11 25,000U
Ⓕ +5V REGULATOR P/O A5
R35 2.15K
U1
CR14
R9 50K
R8 51.1K
CR17 16.2V
C4 220P
R7 1K
U2
+5V SERIES PASS TRANSISTOR
P/O HEAT SINK PC BOARD 05508-20006
Q1
R5 .07
+5 REG
C3 20U
C2 .01
R3 316
DS
CR1
C5 .01
R2 1K
Ⓓ -15V RECT & ±15V FILTERS P/O A5
CR15
CR16
+15V RECTIFIER
P/O HEAT SINK PC BOARD 05508-20006
CR2
F2 5A
R14 4.64K
C16 10,000U
R16 46.4K
C1 500U
Ⓖ +15V HEAD REGULATOR P/O A5
R13 100K
C14 220P
CR8 7.15V
R31 1.21K
R32 215
U5
R33 50K
R34 21.5
CR5
C9 .01
R19 1K
R30 100K
+15V SERIES PASS TRANSISTOR
P/O HEAT SINK PC BOARD 05508-20006
Q2
R18 .07
+15 VH
C8 20U
C10 .01
R21 1K
Ⓗ +15V REGULATOR P/O A5
CR10
U6
C13 0.1
C15 0.1
CR11
TP4
R29 1K
DS4
22 +15V TO A3J1-22 VIA W1
11 +15V TO A4J6-11 VIA W3
7 TO A4J6-7
12 TO A4J6-12
13 TO A4J6-13
Ⓑ BEAM STRENGTH AMPLIFIER P/O A5
BEAM STRENGTH FROM LASER HEAD VIA A4J6-9 AND W3
J3
R24 316
+15V INTERNAL
R28 10K
CR6 6.19V
C12 .01
R27 5.11K
+15INT
U4
R23 100K
-15INT
+5V
R22 9.09K
R25 7.5K
CR7 6.19V
41 METER DRIVE TO FRONT PANEL METER VIA A1J1-41 & W1
10 METER DRIVE TO REMOTE CONTROL UNIT VIA A4J6-10 & W3
Ⓔ -15V REGULATOR P/O A5
CR3
U3
C7 0.1
C6 0.1
CR2
TP2
R15 1K
DS2
8 -15V TO A4J6-8 VIA W3
24 -15V TO A3J1-24 VIA W1


T1 SECONDARIES W4
T1 PRIMARY
B1
GRA
BLK
BLK
BLK
ORN
20V
100V
BLK/YEL
BLK/GRN
120V
BLK/RED
BLU
BRN
BRN
BLU
RED
YEL
YEL
RED
C +5V INTERCONNECT P/O A5
+5V RECTIFIER
P/O HEAT SINK PC BOARD 05508-20006
I +5V FILTER P/O A5
F1 5A
R12 2.15K
C11 25,000U
F +5V REGULATOR P/O A5
R35 2.15K
U1
CR17 16.2V
R9 50K
R8 51.1K
CR14
C4 220P
R7 1K
U2
+5V SERIES PASS TRANSISTOR
P/O HEAT SINK PC BOARD 05508-20006
Q1
Q1
CR1
C5 .01
R2 1K
R5 .07
+5 REG
C3 20U
C2 .01
R3 316
DS1
R4 100
CR12 6V
TP1
TP5
+5V REG TO A1J1,A2J1,A3J1 VIA W1
GND TO A1J1,A2J1,A3J1 VIA W1
26 +5V REMOTE SENSE TO A2J1-26
D -15V RECT & ±15V FILTERS P/O A5
CR15
CR16
R16 46.4K
C1 500U
+15V RECTIFIER
P/O HEAT SINK PC BOARD 05508-20006
CR2
F2 5A
R14 4.64K
C16 10,000U
G +15V HEAD REGULATOR P/O A5
R13 100K
C14 220P
CR8 7.15V
U5
R31 1.21K
R32 215
+15V SERIES PASS TRANSISTOR
P/O HEAT SINK PC BOARD 05508-20006
Q2
Q2
R33 50K
R34 21.5
CR5
C9 .01
R19 1K
R30 100K
R18 .07
+15 VH
C8 20U
C10 .01
R21 1K
DS3
CR13 17V
TP3
+15VH TO A4J6 VIA W3
GND
14 +15VH REMOTE SENSE FROM LASER HEAD VIA A4J6-14 AND W3
H +15V REGULATOR P/O A5
CR10
U6
C13 0.1
C15 0.1
CR11
R20 1K
DS4
TP4
22 +15V TO A3J1-22 VIA W1
11 +15V TO A4J6-11 VIA W3
7 TO A4J6-7
12 TO A4J6-12
13 TO A4J6-13
41 METER DRIVE TO FRONT PANEL METER VIA A1J1-41 & W1
10 METER DRIVE TO REMOTE CONTROL UNIT VIA A4J6-10 & W3
CR7 6.19V
E -15V REGULATOR P/O A5
CR3
U3
C7 0.1
C6 0.1
CR2
R15 1K
DS2
TP2
8 -15V TO A4J6-8 VIA W3
24 -15V TO A3J1-24 VIA W1
5508-J-6A

NOTES:

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN FARADS;
   INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.

REFERENCE DESIGNATIONS

CHASSIS
B1 CR1-2 J1 S1-2 T1 Q1-2
A5
C1-16 CR1-3,5-8, 10-17 DS1-4 F1-2 J1,3-5 Q1-2 R2-5,7-9, 12-16,18, 19,21-25, 27-35 TP1-5 U1-6
DELETED
R1,6,10,11, 17,20,26 CR4,9 J2

TABLE OF ACTIVE ELEMENTS

REFERENCE DESIGNATOR	HP PART NO.	MFR PART NO.
	A5	
Q1,2	1854-0215	2N3904
U1	1826-0650	1826-0650
U2,5	1826-0311	MLM201AP1
U3	1826-0214	MC7915CT
U4	1820-0493	LM307N
U6	1826-0607	1826-0607
	CHASSIS	
CR1,2	1906-0261	MUR1615CT
Q1,2	1854-0669	2N6057

TRANSFORMER WIRING COLOR CODE

Pin No.	Wire Color Code
1	Brown
2	Brown
3	Yellow
4	Yellow
5	Blue
6	Blue
7	Red
8	Red

W3 WIRING COLOR CODE

Pin No.	Wire Color Code
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Gray
9	White
10	Black
11	Brown
12	Red
13	Orange
14	Yellow

CABLE W5 WIRE COLOR CODE

Pin No.	Wire Color Code
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Gray
9	White
10	Black
11	Brown
12	Red
13	Orange
14	Yellow
15	Green

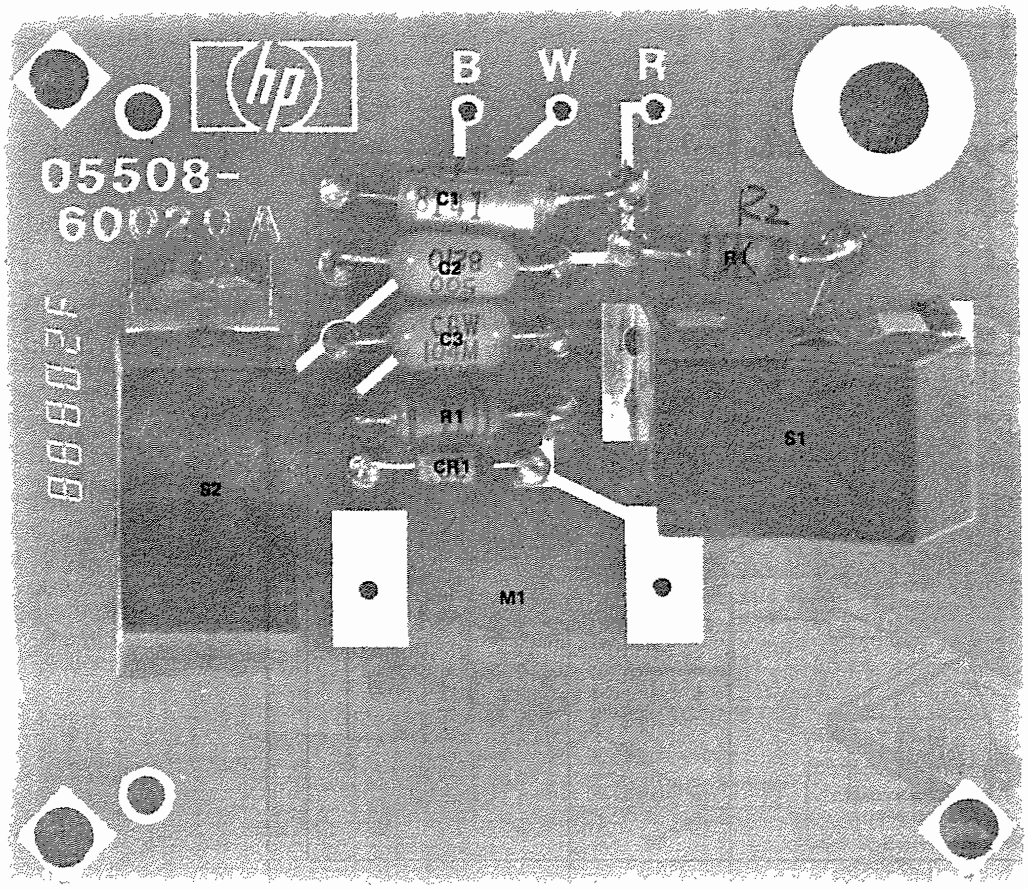
Figure 8-B-32. 5508A A5 Power Supply Board 05508-60005

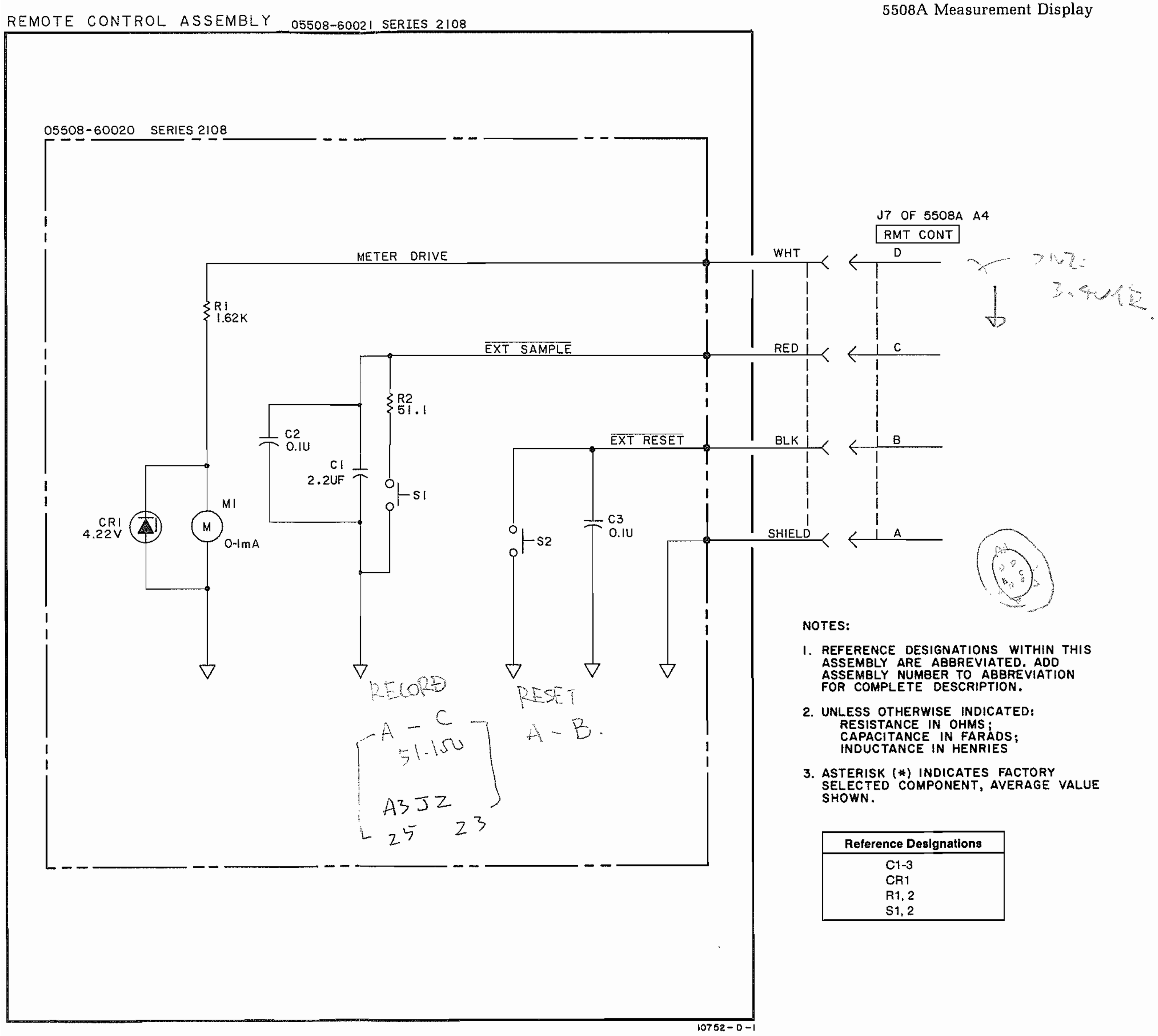
Figure 8-B-32
5508A A5 POWER SUPPLY BOARD 05508-60005

(See Page 8-B-115)

8-B-365. 5508A REMOTE CONTROL UNIT

8-B-366. The Remote Control Unit is supplied with the 5508A and allows the Measurement Display to be reset from a remote location. The RESET switch duplicates the 5508A RESET function. Operation of the Laser Head is unaffected by the reset function. Provision is also made to remotely select a record function to output data to calculators, plotters, and monitors. This is implemented by the RECORD switch and triggers the 5508A. The function is similar to the AUTO RECORD function on the 5508A. A beam strength meter is included in the Remote Control Unit and duplicates the function in the 5508A beam strength meter.




REMOTE CONTROL ASSEMBLY 05508-60021 SERIES 2108
05508-60020 SERIES 2108
METER DRIVE
R1 1.62K
EXT SAMPLE
R2 51.1
C2 0.1U
C1 2.2UF
S1
EXT RESET
S2
C3 0.1U
CR1 4.22V
M
M1
0-1mA
J7 OF 5508A A4
RMT CONT
WHT
RED
BLK
SHIELD
D
C
B
A
7kΩ:
3.4kΩ.
RECORD
A – C
51.1Ω
A3J2
25 23
RESET
A – B.
10752-D-1

NOTES:

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN FARADS;
   INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.

Reference Designations
C1-3
CR1
R1, 2
S1, 2

Figure 8-B-33. Remote Control Unit 05508-60021

Figure 8-B-33
REMOTE CONTROL UNIT 05508-60021

(See Page 8-B-117)

SECTION VIII-C
5518A LASER HEAD

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Block Diagram 8-C-3
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A2 Measurement Receiver and Turret Switch Circuit Theory 8-C-21
A2 Measurement Receiver Troubleshooting 8-C-22

A3 Controller/Reference Board Circuit Theory 8-C-24
A3 Controller/Reference Board Troubleshooting 8-C-27

A4 Sampler Board Circuit Theory 8-C-27

A1 Connector Board Schematic Diagram 8-C-37

A2 Measurement Receiver Schematic Diagram 8-C-39

A3 Controller/Reference Board and A4 Sampler Schematic Diagram 8-C-41

SECTION VIII-C
5518A LASER HEAD

8-C-1. 5518A LASER HEAD BLOCK DIAGRAM DESCRIPTION

8-C-2. The major structures of the 5518A (see Figure 8-C-1, 5518A Block Diagram) are the 5518A control electronics, the laser assembly, the sampler assembly, the turret optics, the measurement receiver, and the reference receiver. The 5518A requires only power input from the 5508A, all control signals are internally generated. The 5518A output signal called Reference Frequency is enabled when the laser tuning is stablized. Laser tuning is stabilized by the control electronics. The output signals, Measurement Frequency and Beam Strength, require proper alignment of measurement optics in addition to stable tuning.

8-C-3. The control electronics control the tuning of the laser assembly in order to provide an accurate laser wavelength for making measurements. When properly tuned, the laser assembly outputs two laser frequencies. One laser frequency, F2, is polarized parallel to the bottom of the 5518A chassis. The other laser frequency, F1, is polarized perpendicular to F2. The wavelengths of the two laser frequencies differ only slightly because the difference frequency between F2 and F1 is small compared to their optical frequency.

8-C-4. Before the laser light is emitted from the 5518A, a portion of it is sampled by the sampler assembly. Most of this sample is fed into the reference receiver and the remainder of the sample is used to control laser tuning.

8-C-5. The reference receiver generates the TTL level square wave signal, Reference Frequency, by mixing the two laser frequencies. The reference frequency, 1.5 to 2.0 MHz, is the difference in frequency between the two laser frequencies. The measurement receiver generates the TTL square wave signal, Measurement Frequency, by mixing the two laser frequencies after they have returned from the measurement optics. The measurement and reference frequency signals are transmitted to the 5508A in differential form.

8-C-6. During a measurement, the laser beam is directed through measurement optics and then returned to the measurement receiver. If the optics remain stationary, the measurement frequency and the reference frequency are the same. Relative motion between the measurement optics results in a change of the measurement frequency. The 5508A compares the measurement frequency to the reference frequency and calculates the displacement of the optics.

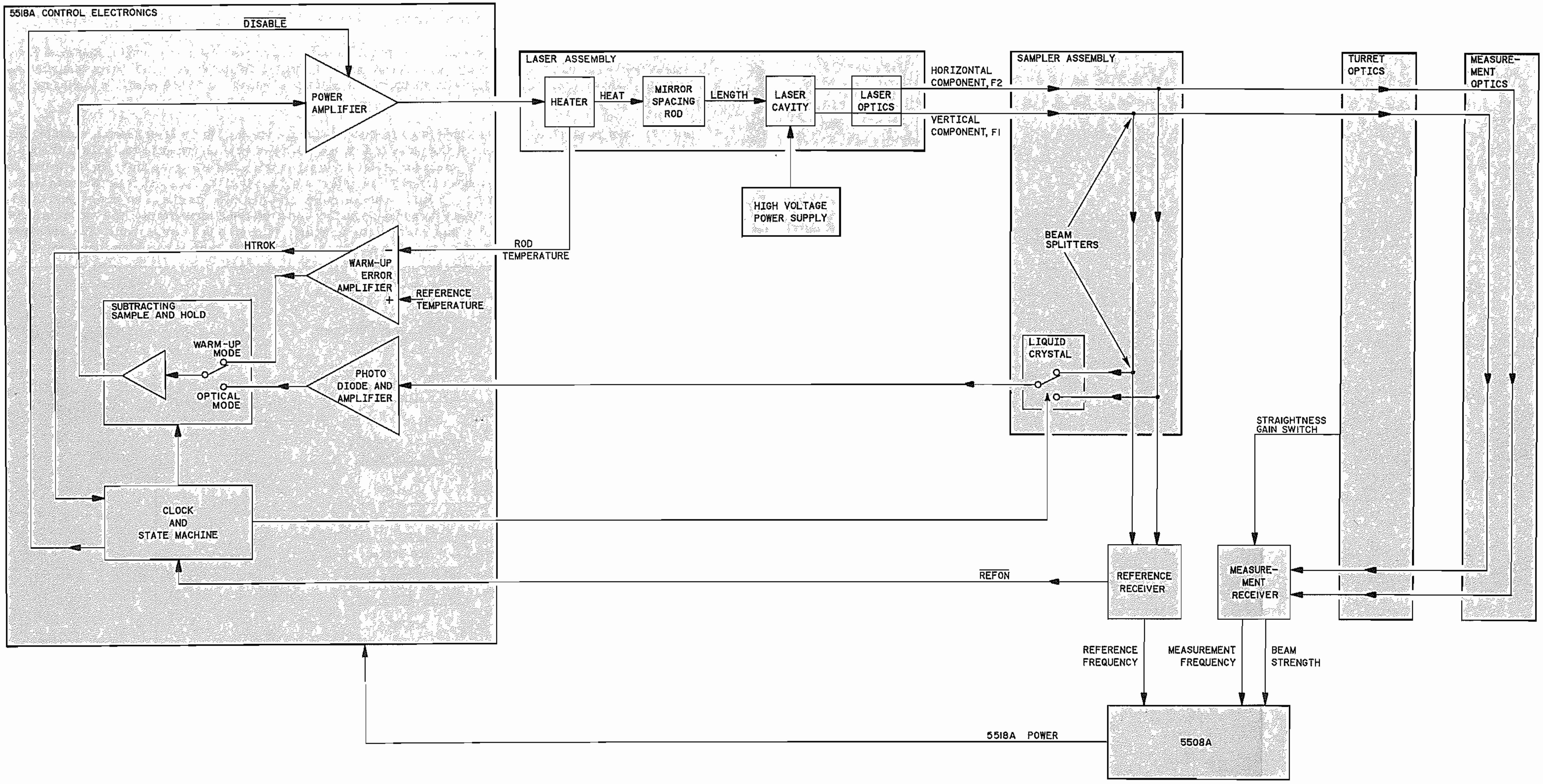
5518A CONTROL ELECTRONICS
DISABLE
POWER AMPLIFIER
LASER ASSEMBLY
HEATER
HEAT
MIRROR SPACING ROD
LENGTH
LASER CAVITY
LASER OPTICS
HORIZONTAL COMPONENT, F2
VERTICAL COMPONENT, F1
SAMPLER ASSEMBLY
TURRET OPTICS
MEASUREMENT OPTICS
HIGH VOLTAGE POWER SUPPLY
HTROK
ROD TEMPERATURE
WARM-UP ERROR AMPLIFIER
REFERENCE TEMPERATURE
SUBTRACTING SAMPLE AND HOLD
WARM-UP MODE
OPTICAL MODE
PHOTO DIODE AND AMPLIFIER
BEAM SPLITTERS
LIQUID CRYSTAL
STRAIGHTNESS GAIN SWITCH
CLOCK AND STATE MACHINE
REFON
REFERENCE RECEIVER
MEASUREMENT RECEIVER
REFERENCE FREQUENCY
MEASUREMENT FREQUENCY
BEAM STRENGTH
5518A POWER
5508A

Figure 8-C-1. 5518A Laser Head Block Diagram

Figure 8-C-1
5518A LASER HEAD BLOCK DIAGRAM

(See Page 8-C-3)

8-C-7. Laser Tuning

8-C-8. The laser assembly will produce stable frequency components only when the laser assembly cavity length is properly controlled. The cavity length is determined by the separation of two mirrors that are held against the ends of a glass rod. The 5518A uses a thermal tuning technique to control the cavity length. Cavity length increases when the rod is heated and decreases when it cools.

8-C-9. A heater coil wrapped around the glass rod is used to increase the cavity length. Rod cooling by conduction to surrounding material is used to decrease cavity length. To properly control the rod temperature, the rate at which it cools should approximate the rate at which it is heated. The 5518A raises the cooling rate by maintaining the rod at an elevated temperature.

8-C-10. Warm-up Mode Tuning. One of two feedback loops used to control the laser assembly establishes the initial operating temperature of the glass rod. When power is first supplied to the 5518A, the state machine (see Figure 8-C-2 State Diagram for State Machine), resets to its warm-up mode. In the warm-up mode, the state machine controls the subtracting sample and hold so that the feedback is as shown in Figure 8-C-3, Feedback Loop During Warm-up Mode. The warm-up error amplifier produces an error signal that is proportional to the difference between the rod temperature and a reference temperature. The warm-up mode feedback loop controls the rod temperature until it equals the reference temperature. The reference temperature is adjustable and factory set to be higher than the hottest expected ambient temperature.

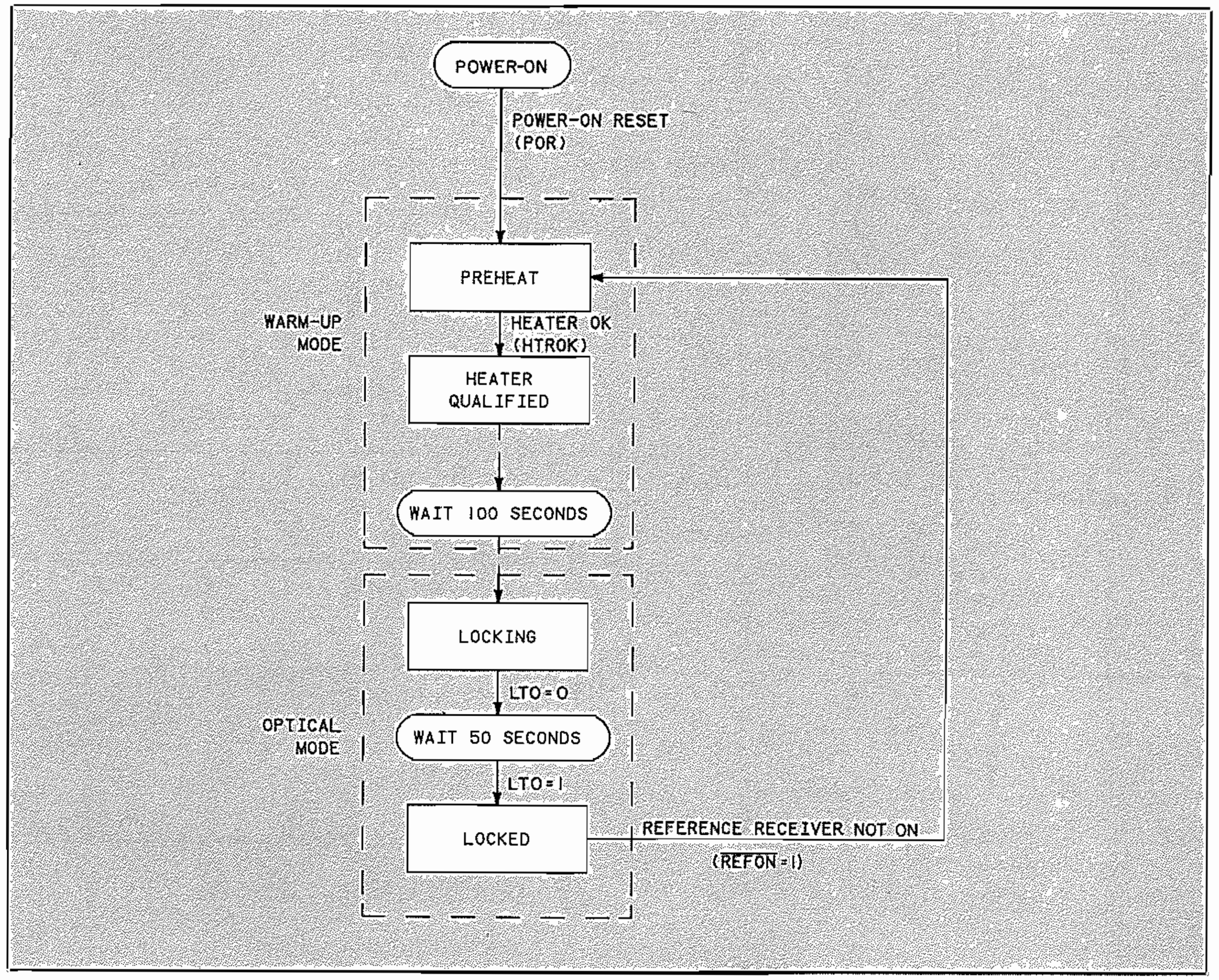

Figure 8-C-2. State Diagram for State Machine

Figure 8-C-1
5518A LASER HEAD BLOCK DIAGRAM

(See Page 8-C-3)

8-C-7. Laser Tuning

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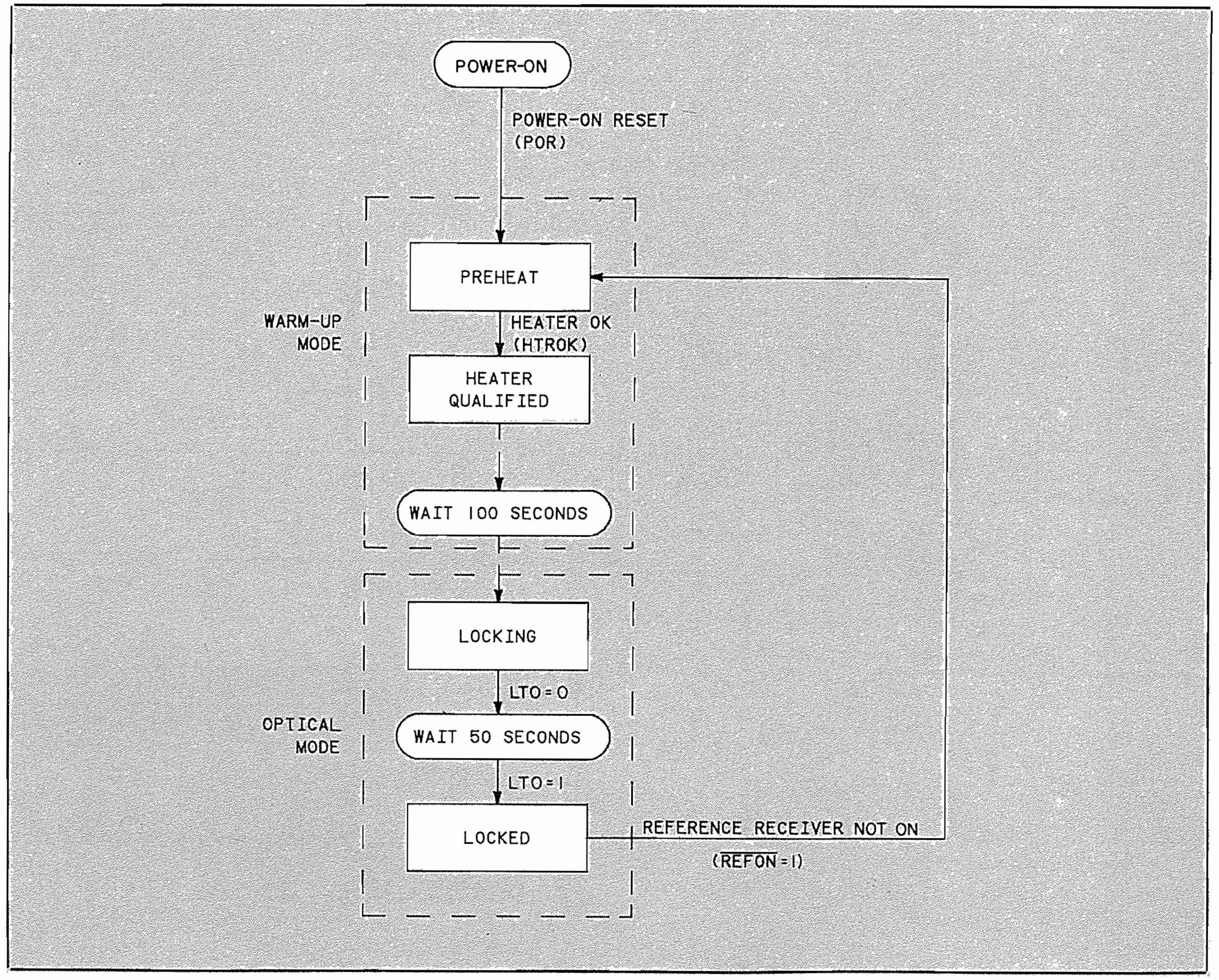


Figure 8-C-2. State Diagram for State Machine

8-C-11. The rod heater coil is used both to heat the rod and to sense its temperature. For 2.56 seconds (nominal) out of every 25.6 seconds (nominal) of the warm-up cycle (see Figure 8-C-4, Warm-up Mode Timing Diagram), the state machine disables the power amplifier and the heater allowing the heater coil to stabilize to the rod temperature. The heater coil and a resistor in the power amplifier form a voltage divider. As the heater resistance increases with rising temperature, the divider voltage increases. The difference between this voltage and the reference voltage is amplified to provide the warm-up mode error signal.

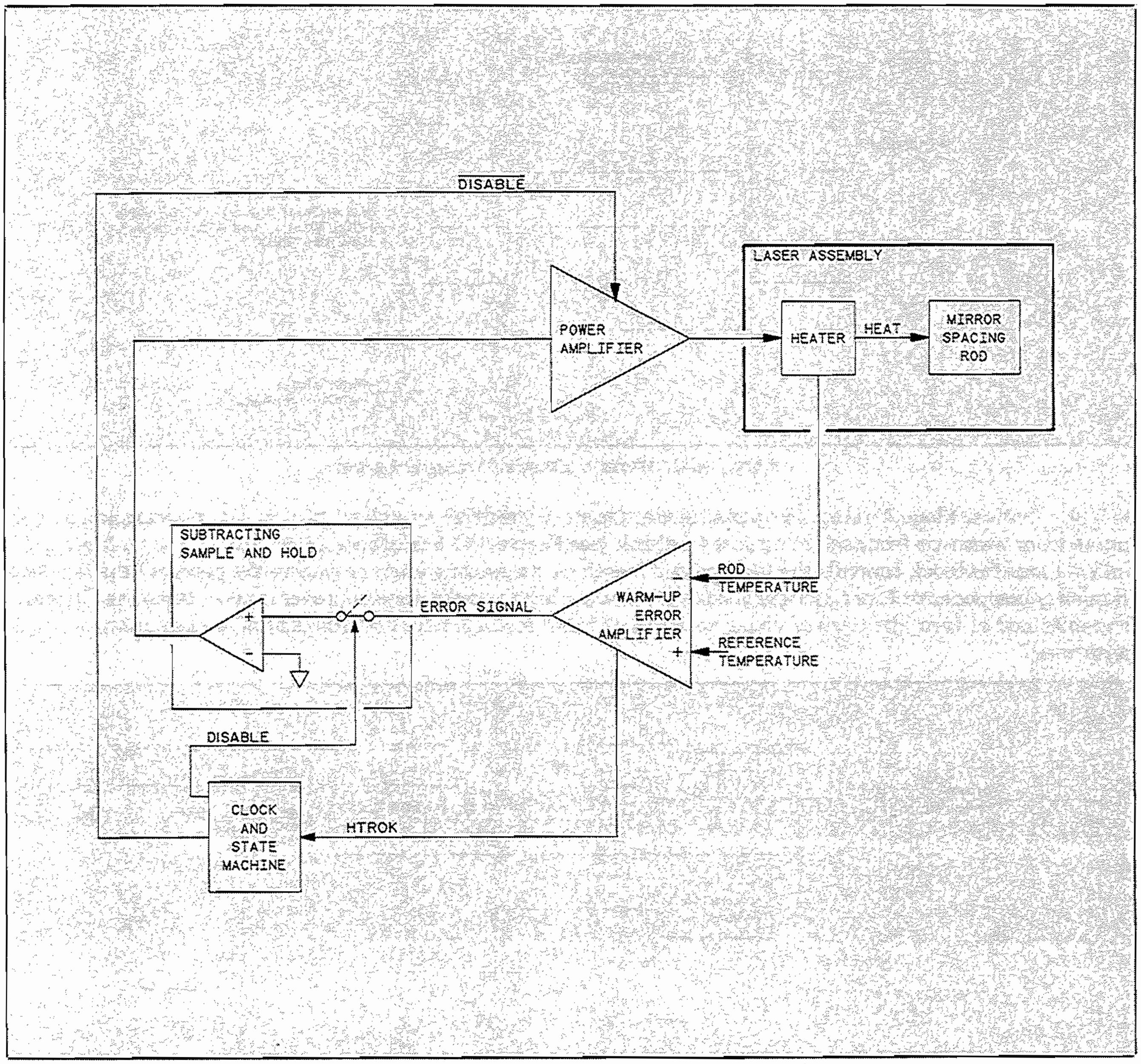

DISABLE
LASER ASSEMBLY
POWER AMPLIFIER
HEATER
HEAT
MIRROR SPACING ROD
SUBTRACTING SAMPLE AND HOLD
+
-
ERROR SIGNAL
WARM-UP ERROR AMPLIFIER
ROD TEMPERATURE
REFERENCE TEMPERATURE
DISABLE
CLOCK AND STATE MACHINE
HTROK

Figure 8-C-3. Feedback Loop during Warmup Mode

8-C-12. At the end of the 2.56 second disable period, the heater coil temperature has settled to the rod temperature. The error signal is sampled and held and the power amplifier is enabled. During the rest of the 25.6 second period, the power amplifier, re-enabled and under control of the sampled error signal, drives the heater.

8-C-13. When the error signal gets close to zero, the warm-up error amplifier sends a digital signal called Heater O.K. (HTROK) to the state machine. HTROK is sampled by the state machine whenever the error signal is sampled. After HTROK is sampled true, the state machine waits 100 seconds before switching to optical mode.

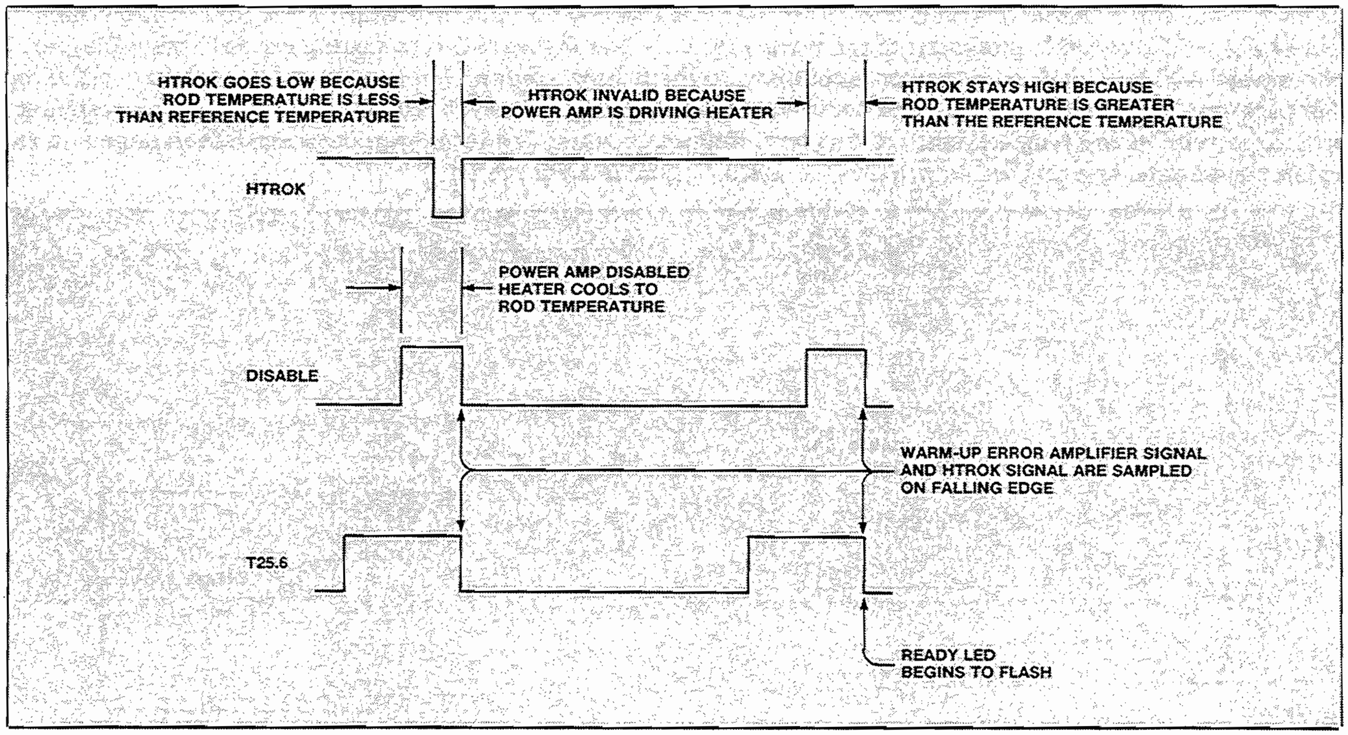

HTROK GOES LOW BECAUSE ROD TEMPERATURE IS LESS THAN REFERENCE TEMPERATURE
HTROK INVALID BECAUSE POWER AMP IS DRIVING HEATER
HTROK STAYS HIGH BECAUSE ROD TEMPERATURE IS GREATER THAN THE REFERENCE TEMPERATURE
HTROK
POWER AMP DISABLED HEATER COOLS TO ROD TEMPERATURE
DISABLE
WARM-UP ERROR AMPLIFIER SIGNAL AND HTROK SIGNAL ARE SAMPLED ON FALLING EDGE
T25.6
READY LED BEGINS TO FLASH

Figure 8-C-4. Warm-up Mode Timing Diagram

8-C-14. Optical Mode Tuning. In optical mode, the state machine switches the subtracting sample and hold inputs from warm-up feedback to optical feedback (see Figure 8-C-5 Feedback Loop during Optical Mode). The optical mode feedback controls the laser cavity length by measuring and comparing the power of the two laser frequency components. Cavity length is controlled such that the difference in power is zero. When the difference is maintained at zero, the desired characteristics of the laser beam are established and a measurement can be performed.

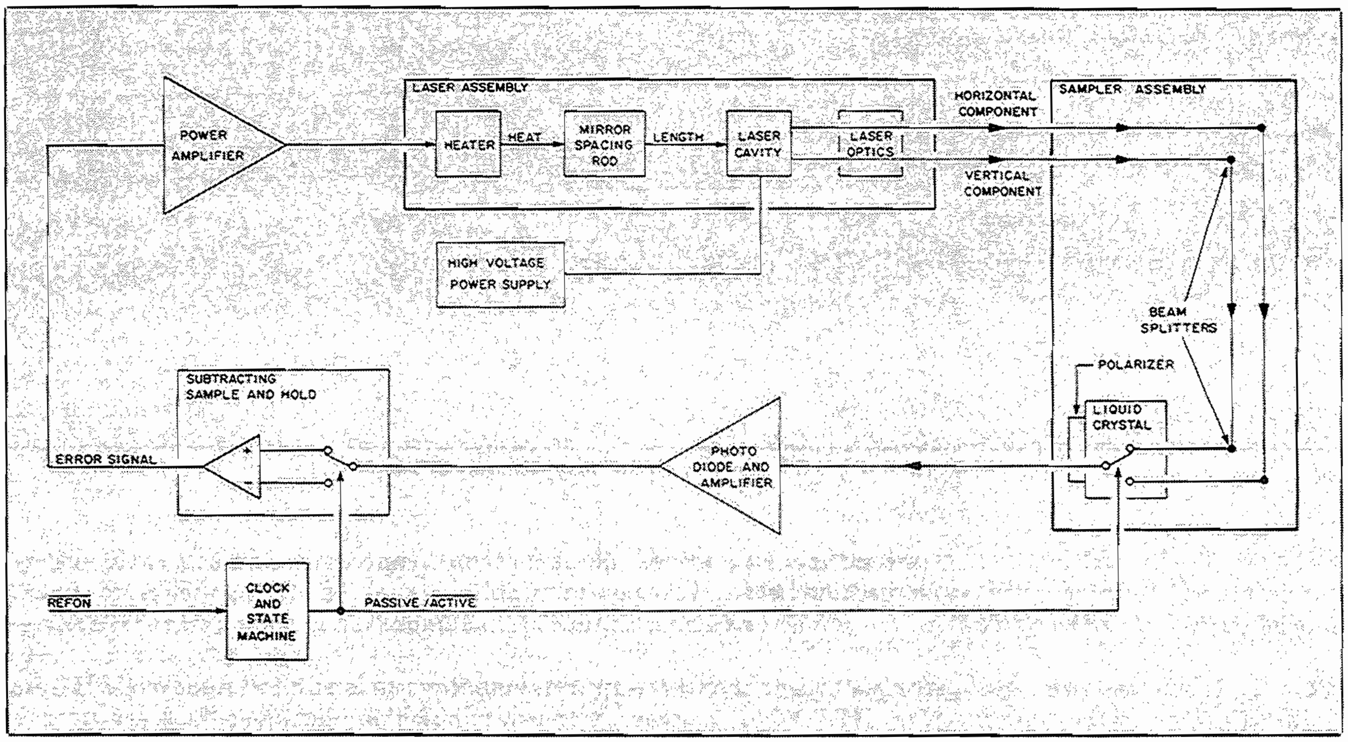

POWER AMPLIFIER
LASER ASSEMBLY
HEATER
HEAT
MIRROR SPACING ROD
LENGTH
LASER CAVITY
LASER OPTICS
HORIZONTAL COMPONENT
VERTICAL COMPONENT
SAMPLER ASSEMBLY
HIGH VOLTAGE POWER SUPPLY
BEAM SPLITTERS
POLARIZER
LIQUID CRYSTAL
SUBTRACTING SAMPLE AND HOLD
ERROR SIGNAL
+
-
PHOTO DIODE AND AMPLIFIER
REFON
CLOCK AND STATE MACHINE
PASSIVE/ACTIVE

Figure 8-C-5. Feedback Loop during Optical Mode

8-C-15. The power in each laser frequency component is measured by sampling some of the laser light with a pair of non-polarizing beam splitters (see Figure 8-C-6, A7 Sampler Assembly, Exploded View) and passing one of the laser frequency components, then the other, through an optical switch and onto a photodiode. The beam splitters are part of the A7 Sampler Assembly and the photodiode is mounted on the A4 Sampler Board. A liquid crystal and a polarizer comprise the optical switch.

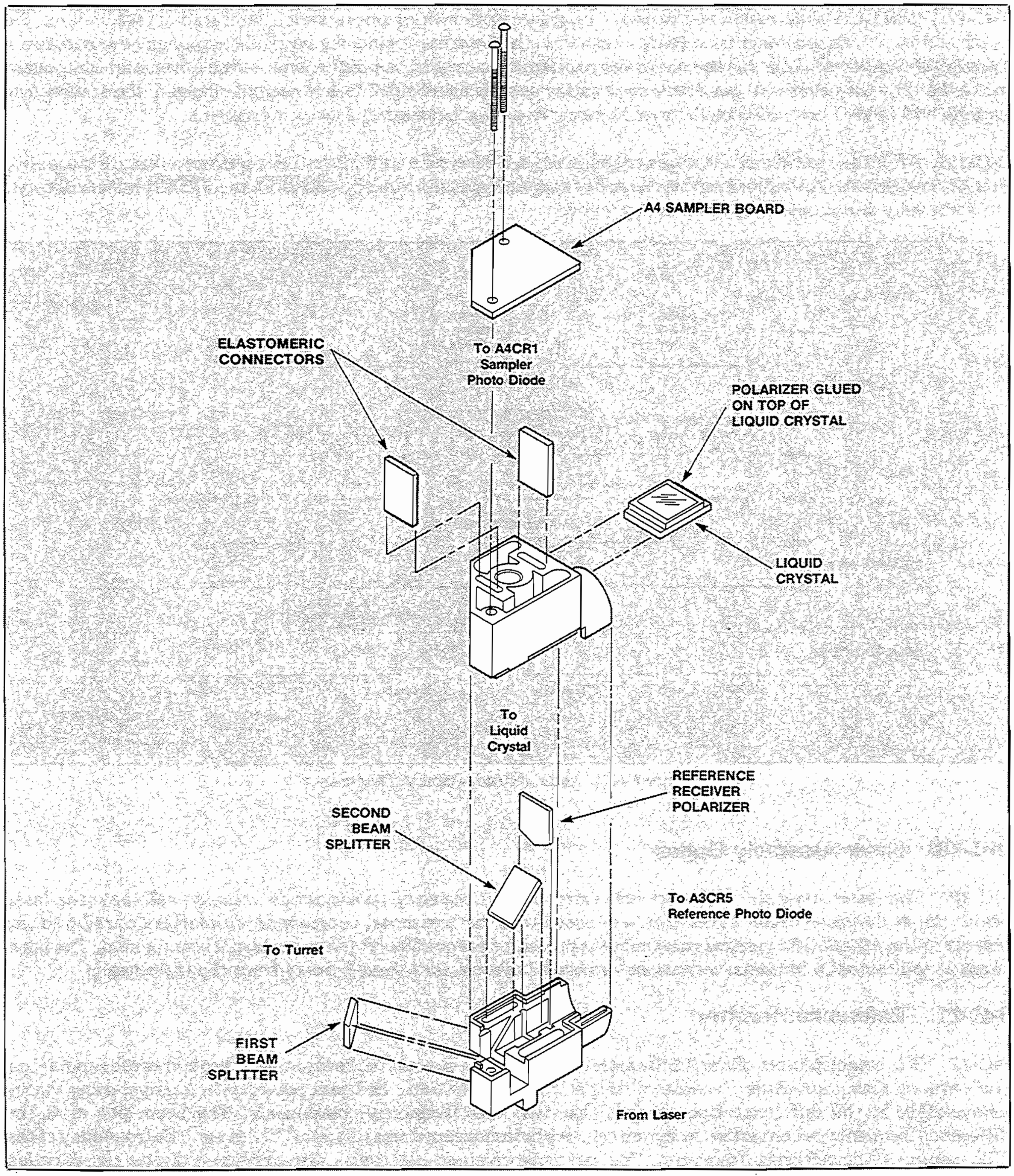

A4 SAMPLER BOARD
ELASTOMERIC CONNECTORS
To A4CR1 Sampler Photo Diode
POLARIZER GLUED ON TOP OF LIQUID CRYSTAL
LIQUID CRYSTAL
To Liquid Crystal
REFERENCE RECEIVER POLARIZER
SECOND BEAM SPLITTER
To A3CR5 Reference Photo Diode
To Turret
FIRST BEAM SPLITTER
From Laser

Figure 8-C-6. Sampler Assembly, Exploded View

8-C-16. When the state machine excites the liquid crystal into its active state (see Figure 8-C-7, Optical Mode Timing Diagram), the laser beam passes through the liquid crystal unaltered. The polarizer blocks the horizontal component and passes the vertical component onto the photodiode. The photodiode current is proportional to the power in the vertical component and is amplified and converted to a voltage by the photodiode amplifier. The voltage is held on the positive input of the subtracting sample and hold.

8-C-17. When the state machine places the liquid crystal in its passive state, the liquid crystal rotates the polarization of both components by 90 degrees. Now, the polarizer blocks the vertical component and passes the horizontal component. The voltage out of the photodiode amplifier is proportional to the horizontal component and is held by the negative input of the subtracting sample and hold. The error signal output of the subtracting sample and hold is proportional to any difference in power between the two components.

8-C-18. After the optical mode tuning has stabilized, LTO is held true. LTO true enables the reference frequency output. Proper laser tuning and reference receiver operation is indicated by $\overline{\text{REFON}}$ true. $\overline{\text{REFON}}$ false will cause the state machine to reset to the warm-up mode.

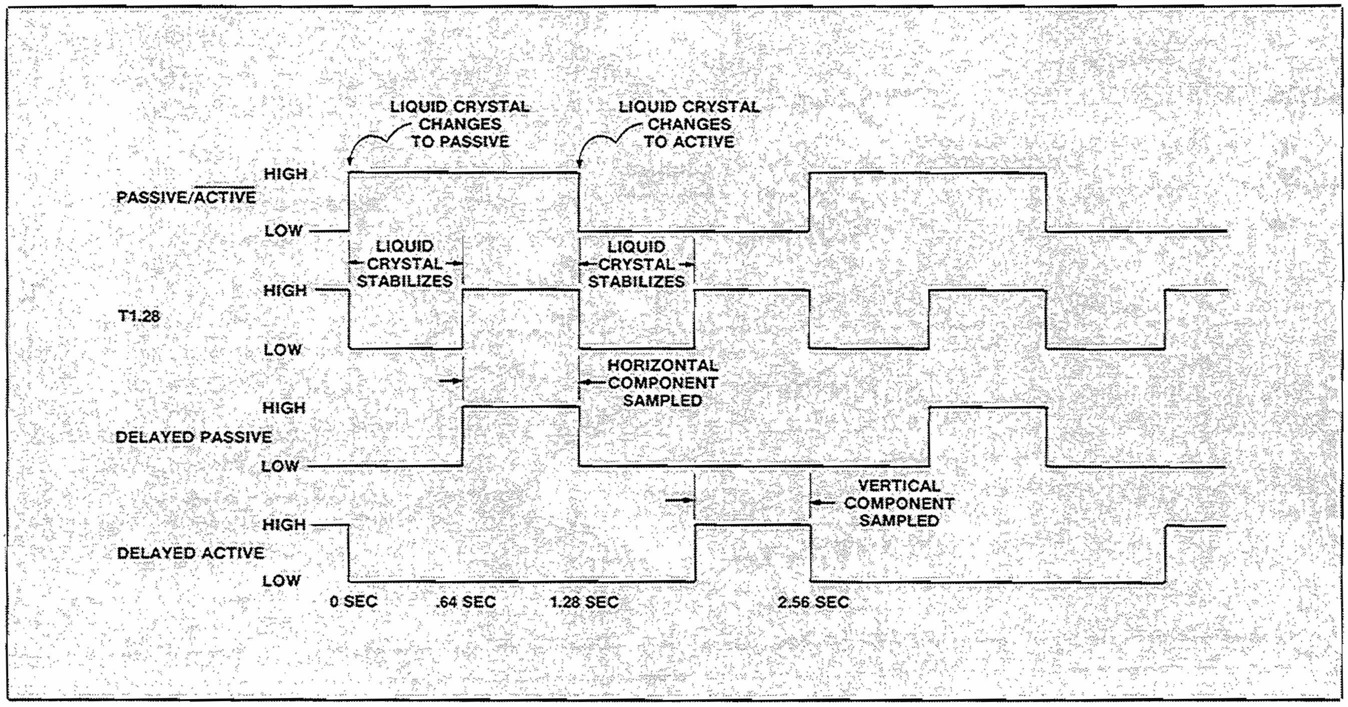

LIQUID CRYSTAL CHANGES TO PASSIVE
LIQUID CRYSTAL CHANGES TO ACTIVE
HIGH
PASSIVE/$\overline{\text{ACTIVE}}$
LOW
LIQUID CRYSTAL STABILIZES
LIQUID CRYSTAL STABILIZES
HIGH
T1.28
LOW
HORIZONTAL COMPONENT SAMPLED
HIGH
DELAYED PASSIVE
LOW
VERTICAL COMPONENT SAMPLED
HIGH
DELAYED ACTIVE
LOW
0 SEC
.64 SEC
1.28 SEC
2.56 SEC

Figure 8-C-7. Optical Mode Timing Diagram

8-C-19. Laser Assembly Optics

8-C-20. The laser assembly optics ensure correct laser frequency polarizations and also collimate the laser beam. When the laser beam leaves the laser assembly, the horizontal component is polarized parallel to the bottom of the 5518A. The vertical component is polarized perpendicular to the horizontal component. The laser beam is collimated to minimize variations in beam diameter as it travels away from the laser head.

8-C-21. Reference Receiver

8-C-22. The beam splitters of the A7 Sampler Assembly direct some of the laser light through another polarizer and onto another photodiode. Because of the polarizer orientation, the beam power after this polarizer varies sinusoidally at the difference frequency of the two laser frequency components. The beam power at the difference frequency is converted to current by the photodiode and amplified to TTL levels. The frequency of the TTL output is the reference frequency. The reference receiver electronics also provide a digital signal called Reference Receiver On (REFON) that tells the state machine the laser is working properly.

8-C-23. Measurement Frequency Receiver

8-C-24. During a measurement, the vertical and horizontal components pass through the turret and measurement optics and return to the measurement receiver. The difference between their frequencies will change whenever the measurement optics are moving. The measurement frequency is detected and amplified using the same technique as described for the reference receiver. The measurement receiver is composed of a chassis mounted polarizer and the A2 Measurement Receiver Board.

8-C-25. The measurement receiver electronics also produce a current signal, BEAM STRENGTH, that is proportional to the optical power at the measurement frequency. During straightness measurements, a switch in the turret assembly increases the gain of the measurement receiver to compensate for losses in the straightness mount.

8-C-26. Turret Optics

8-C-27. The major component of the turret assembly is the straightness mount. When the straightness mount is set to STRAIGHT, the laser beam exits from and returns to the 5518A through the exit aperture (see Straightness Mount, Side View, Figure 8-C-8). A beam splitter in the straightness mount transmits approximately 30% of the exit beam to the measurement optics and reflects the return beam to a mirror. The mirror reflects this beam to the measurement mirror. A tab on the straightness mount pushes the lever on the straightness switch to close the switch when the straightness mount is set to STRAIGHT. The switch increases the gain of the measurement receiver electronics to compensate for signal reduction due to losses in the straightness mount.

8-C-28. When the straightness mount is set to OTHER, it places nothing in the exit or return aperture. The laser beam exits through the exit aperture and returns through the return aperture.

8-C-29. The exit aperture shutter of the turret assembly has three positions. The first blocks the laser beam entirely; the second allows a small diameter laser beam to exit for optical alignment purposes; and the third passes the entire laser beam. The return beam shutter has two positions. The first provides a target for optical alignment and the second permits the beam to pass to the measurement receiver.

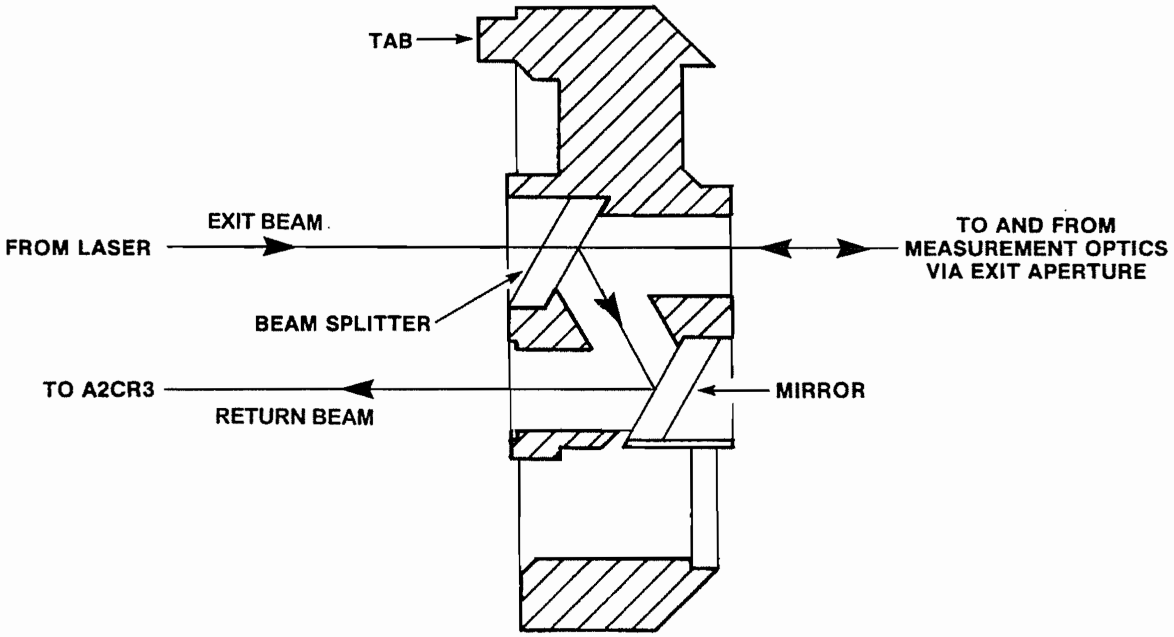


Figure 8-C-8. Straightness Mount, Side View

8-C-30. ASSEMBLY/SCHEMATIC LOCATIONS OF 5518A BLOCK DIAGRAM ELEMENTS

Element	5518A Assembly
Control Electronics	A3 and A4
Power Amplifier	A3
Warm-Up Error Amplifier	A3
Subtracting Sample and Hold	A3
Photodiode and Amplifier	A4 and A3
Clock and State Machine	A3
Laser Assembly	A5
Sampler Assembly	A7
Reference Receiver	A3 and A7
Measurement Receiver	A2 and Chassis Mounted Polarizer
Turret Optics	Turret Assembly

8-C-31. 5518A INDICATORS

LASER ON

An amber indicator installed to alert the operator that the 5518A Laser Head is activated and emitting a laser beam. Electrically, this indicator monitors the +15 Volt line supplied by the 5508A which is used by the 5518A to generate its operating power.

SIGNAL

An amber indicator that indicates when a sufficient laser beam measurement signal is returned to the measurement receiver assembly within the 5518A.

READY

The READY indicator is extinguished when the 5518A is in the warm-up mode. It flashes on and off when the 5518A begins the optical mode and is fully on when the 5518A is ready for use.

8-C-32. BUILT-IN TEST AIDS

8-C-33. SeverA1 jumpers are included to aid in testing. The LIQUID CRYSTAL jumper JMP3 places the liquid crystal in either the active or passive state. JMP7, HEATER, disables the power amplifier. JMP5, PHOTODIODE, substitutes a known current for the photodiode and is used for testing the photodiode amplifier and the subtracting sample and hold circuits. JMP6, $\overline{\text{POWER}}$ AMP, supplies ±100 mV to U13 pin 3 to test the power amplifier. The $\overline{\text{REFON}}$ jumper, JMP2, sets the $\overline{\text{REFON}}$ signal so that U17 cannot influence the state machine. The HTROK jumper, JMP4, sets the HTROK signal so that U15 cannot influence the state machine. If JMP4 is not in NORM, the clock runs at about 75 kHz. The RESET jumper, JMP1, places the state machine in a repetitive mode to allow signature measurements.

NOTE

There are two "LO" positions for the REFON jumper, and two "UP" positions for the POWER ON jumper. For proper placement, refer to the schematic for A3 when using these jumpers.

Paragraph 8-C-34 and Table 8-C-1 have been deleted.

8-C-35. TROUBLE ISOLATION

8-C-36. Quick Tuning Checkout Procedure

8-C-37. The following procedure provides a means to quickly check the entire optical tuning subsystem of the laser. Before performing the procedure, study the information in Paragraphs 8-C-7 through 8-C-18 to gain the necessary background information to aid in interpreting the test results. The following figure illustrates the effects of mirror spacing on F1 and F2.

8-C-38. The procedure consists of monitoring test point TP16 on A3 with an oscilloscope to determine the relative amplitudes of F1 and F2 with the heater turned off. If the sampler, photodiode, and amplifier are functioning properly and the heater is turned off, the traces on the oscilloscope will show switching to different levels as it monitors the sampling of F1 and F2. With continued observation of the trace switching, these levels which correspond to F1 and F2 will change amplitudes since the tuning is uncontrolled.

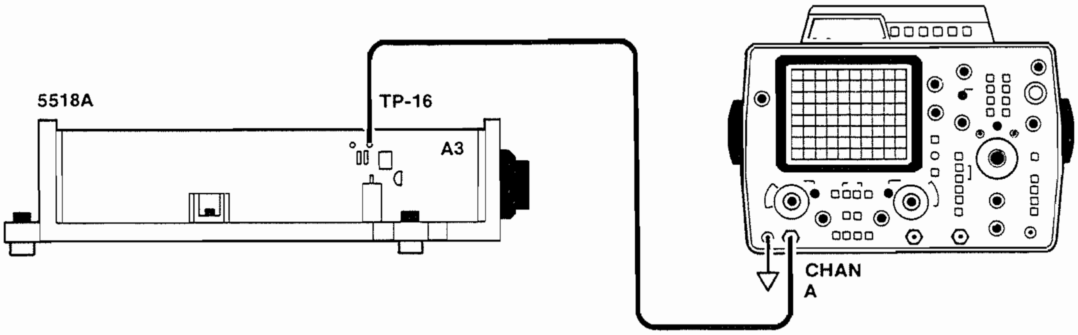
8-C-39. To perform the quick isolation procedure, proceed as follows:

a. Observe the READY LED on the rear panel of the 5518A. If after approximately 2 minutes from power-up, the LED begins flashing, you can assume that the clock, dividers, state machine, warm-up and power amplifier stages are working properly.

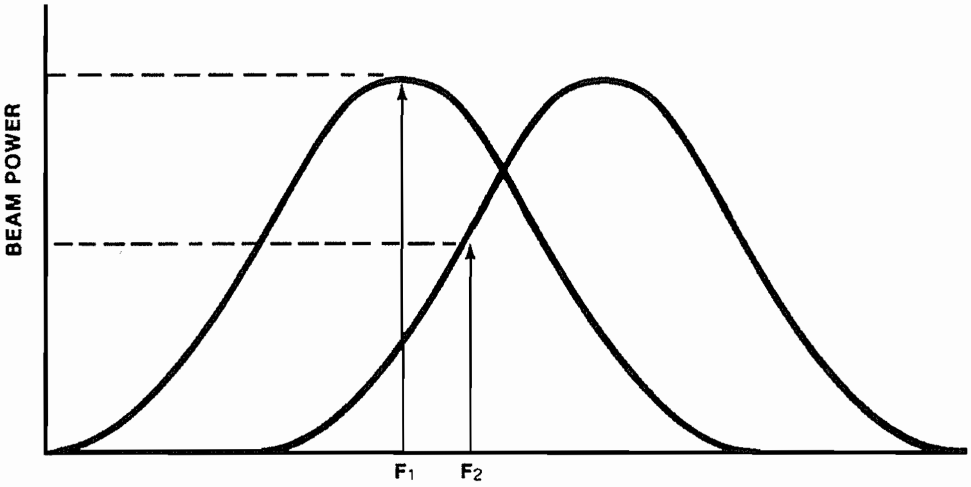
b. Remove the 5518A top cover.

c. Connect a dc coupled oscilloscope to TP16 on A3 as shown below. Also see Figure 8-C-14 for test point locations.

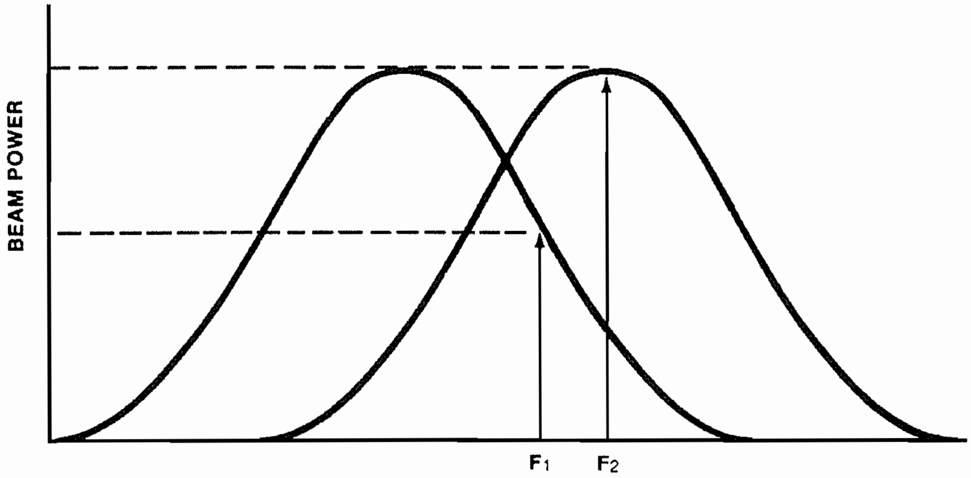
TEST SETUP



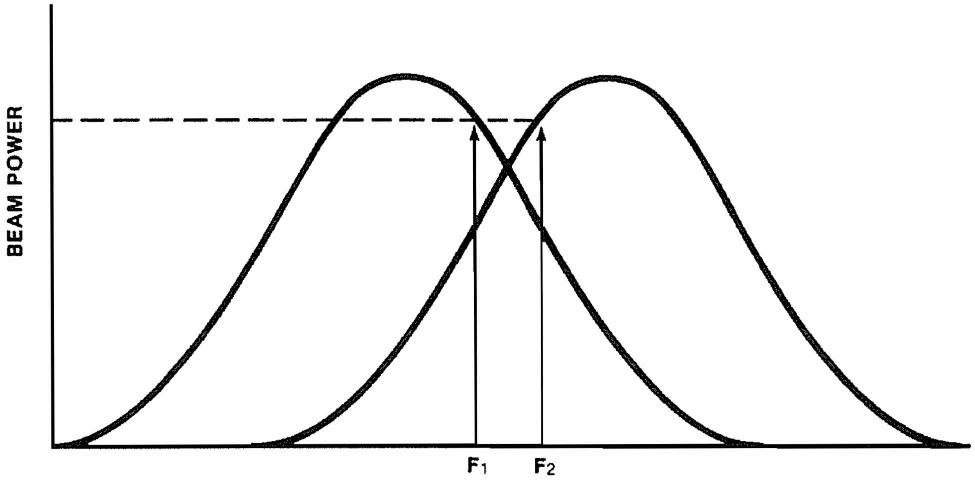
LASER TUBE TUNING CHARACTERISTICS


BEAM POWER
F1
F2

a) SPACING ROD TOO LONG


BEAM POWER
F1
F2

b) SPACING ROD TOO SHORT


BEAM POWER
F1
F2

c) RESONANCE

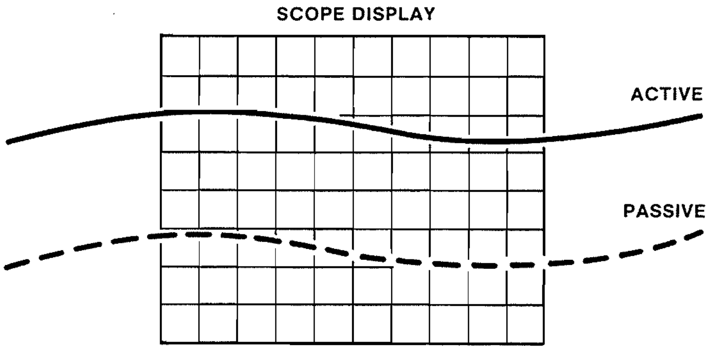
d. On A3, change the small blue HEATER jumper JMP7 from NORM to OFF.

e. Set oscilloscope controls as follows:

  1. Timebase to 2 ms/div or faster.
  2. Trigger to normal. Adjust the triggering for minimum flickering of the trace.
  3. Vertical attenuator to 0.05 V/div for X10 probe use or to 0.5 V/div when using a direct probe. Set coupling to dc.

f. To simulate a failure to observe how the waveforms at TP16 behave, move JMP3 LIQUID CRYSTAL jumper to ACT. Note that the scope trace wanders up and down in a very smooth continuous manner with varying speed. If this occurs in step h, the liquid switch or A3U11 is defective. Return JMP3 LIQUID CRYSTAL jumper to original position.

g. If the sampler, photodiode, and amplifier are working properly, the oscilloscope display will show the trace switch between two distinct levels. See Figure below. With continued observation of the trace switching these levels which correspond to F1 and F2 will change amplitudes since the tuning is uncontrolled.



h. Disconnect the test equipment and set HEATER jumper JMP7 to NORM. Replace the 5518A cover.

8-C-40. TESTING THE LIQUID CRYSTAL SWITCH

8-C-41. The following materiA1 and test equipment is required for the test:

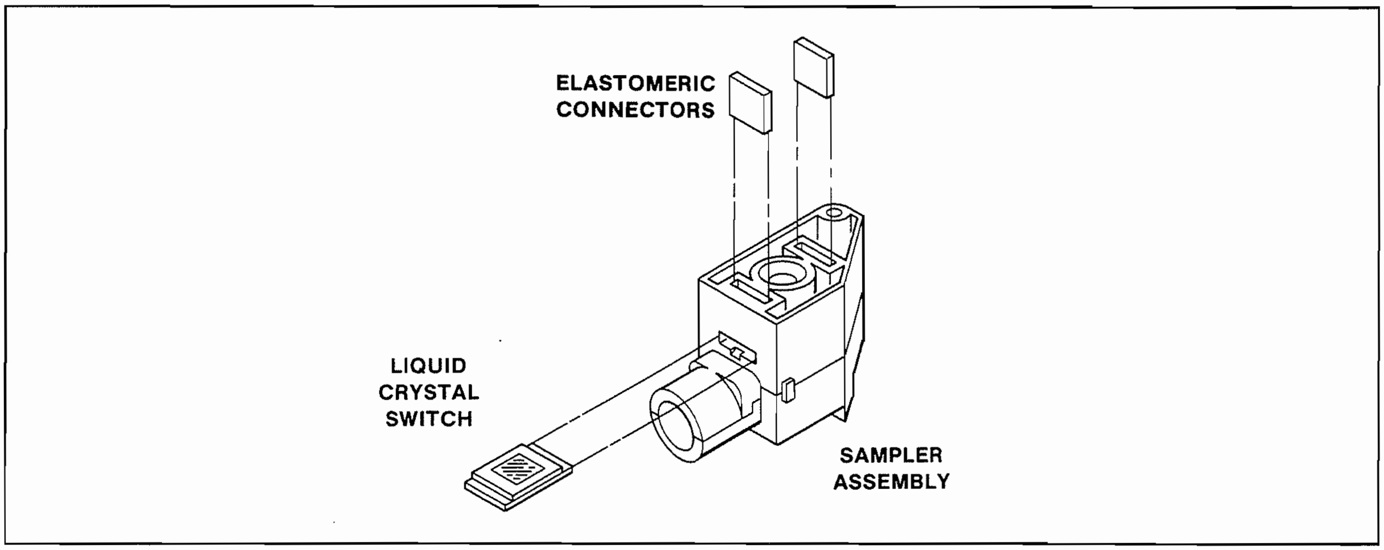
a. A white piece of cardboard.

b. 50 Hz square wave generator (TTL-level).

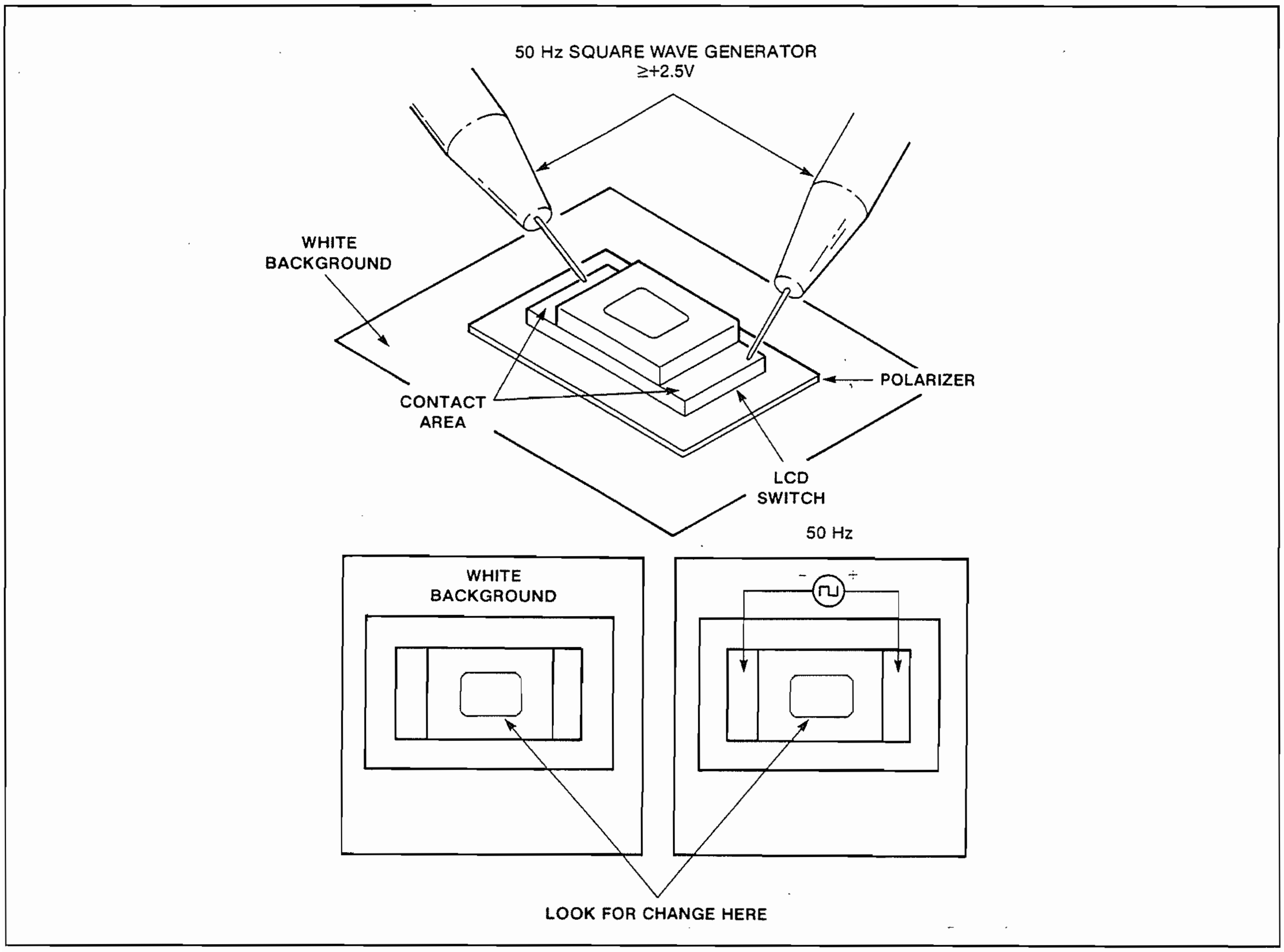
c. A sheet of polarizer materiA1 HP Part Number 1000-0616

8-C-42. To test the liquid crystal, proceed as follows:

a. Remove the liquid crystal from the sampler assembly as shown below.


ELASTOMERIC CONNECTORS
LIQUID CRYSTAL SWITCH
SAMPLER ASSEMBLY

b. Place the liquid crystal in the test setup shown below.


50 Hz SQUARE WAVE GENERATOR
≥+2.5V
WHITE BACKGROUND
CONTACT AREA
POLARIZER
LCD SWITCH
50 Hz
- +
WHITE BACKGROUND
LOOK FOR CHANGE HERE

CAUTION

Do not apply dc voltage across the liquid crystal. Sustained dc current flow through the liquid crystal may damage the device.

c. Gently place the probes of the 50 Hz square wave frequency source on the end shoulders of the liquid crystal as shown and observe the window area, it should go from light to dark while probing the device. A faint change of color or no change indicates a faulty liquid crystal. The replacement HP part number for the liquid crystal is 1990-0768.

8-C-43. 5518A TROUBLE ISOLATION PROCEDURE

8-C-44. Before 5518A trouble isolation is attempted, the 5518A block diagram description (paragraphs 8-C-1 through 8-C-29) should be read. All electronic tests can be performed using an HP 5005 Signature Multimeter.

WARNING

WITH THE 5518A COVER REMOVED, UP TO 12 KILOVOLTS WILL BE PRESENT AT THE OUTPUT OF THE HIGH VOLTAGE POWER SUPPLY ASSEMBLY A6.

8-C-45. Test Setup

a. Connect the 5518A to the 5508A and turn 5508A power on. If no laser light is emitted, check that the exit shutter in the 5518A target assembly is not closed. Otherwise see Laser High Voltage Section Circuit Theory/Troubleshooting in paragraph 8-C-54.

b. Set the turret ring to OTHER. Position a retroreflector (HP 10767A) to return the laser beam to the return aperture with the return shutter open.

c. Wait for the 5508A to display something other than the warm-up countdown. Under normal operation, the countdown starts at 600 seconds and if it reaches zero – LASr FAIL will be displayed. When the laser is ready for operation, the countdown on the 5508A will be replaced by a flashing message – LASr UP. Subsequent errors will cause LASr UP to be replaced by the appropriate error message.

    1. Does the 5508A display LASr FAIL?
    2. If yes see step b in the procedure. If otherwise, see step a in the procedure.

8-C-46. Procedure

a. Does the 5508A display LASr UP?

    1. If LASr UP is displayed, press RESET on the 5508A.
    2. If the 5508A displays Hd ERROR, see step e of the Reference Receiver section of 5518A A3 Troubleshooting (Paragraph 8-C-131).
    3. The 5508A display can change from flashing LASr UP to HEAD ERROR without a RESET switch closure. This can be caused by a reference signal dropout. In this case proceed with step b of this procedure.

NOTE

Hd Error, SL Error, and PA Error messages that occur with the 5518A cover removed should not be considered as errors unless they also occur with the cover on.

    4. If the 5508A displays PA Error or SL Error or displays 0.00000 but the beam strength meter reads zero see the 5518A A2 Measurement Receiver Troubleshooting (Paragraph 8-C-69).
    5. If the 5508A displays anything else then see 5508A servicing.

b. Remove the cover of the 5518A.Verify all boards are seated correctly and all test jumpers on A3 board are to the left (NORM). Turn 5508A power on. Check the following voltages. If any are incorrect see power supply servicing in A3 servicing procedures (Paragraph 8-C-129):

A3TP8 - 14.5V to 15.5V
A3TP9 - 4.75V to 5.25V
A3TP10 - minus 13.8V to minus 14.8V

    1. Turn the 5508A power off for a few seconds, then back on. Observe READY LED on the 5518A. Find the description in steps c through f that matches your observation and follow that step.

c. LED takes longer than 3 minutes to start to blink, e.g., 5508A countdown display is less than 420 when READY LED starts to flash. Either the digital section is not working or the heater is not being heated properly. Check the following procedures:

    A3 Digital Section (Paragraph 8-C-117)
    A3 Power Amplifier (Paragraph 8-C-126)
    A3 Warm-Up Error Amplifier (Paragraph 8-C-127)
    A3 Subtracting Sample and Hold (Paragraph 8-C-124)

d. LED blinks within 3 minutes, blinks for less than 3 minutes, goes off, then repeats this action. This indicates that the warm-up mode feedback is not properly controlling the heater voltage.

    1. Check:

    A3 Power Amplifier (Paragraph 8-C-126)
    A3 Warm-Up Error Amplifier (Paragraph 8-C-127)
    A3 Digital Section (Paragraph 8-C-117)
    A3 Subtracting Sample and Hold (Paragraph 8-C-124)

e. LED blinks within 3 minutes, blinks for less than 3 minutes, comes on for 1 second (twice as long as when it is blinking) then goes off briefly. This action is then repeated. Either the optical mode feedback is not working or the reference receiver is defective.

f. Any other LED observation indicates a defective digital section. See A3 Digital Section Troubleshooting (paragraph 8-C-117). See Quick Tuning Checkout Procedure, Paragraph 8-C-36, and Reference Receiver Troubleshooting, Paragraph 8-C-131.

g. LED blinks within 5 or 10 seconds, comes on for a few minutes after approximately 3 minutes, then starts blinking again. Check A3 Power Amplifier section and especially A3Q3 and A3Q5.

h. Any other LED observation indicates a defective digital section. See A3 Digital Section Troubleshooting, Paragraph 8-117.

i. If a Reference Frequency Signal error is indicated after the laser has successfully reached normal operation (READY LED on continuously and Reference frequency signal output is OK), make the following observation. Does the READY LED extinguish when the failure occurs? If so, the optical tuning may be failing or the reference receiver may be resetting the state machine due to marginal signal strength. Use the Laser Power Output Test (Paragraph 4-16) as a check of the laser assembly and 5518A Quick Tuning Procedure to get an indication of the function of the optical tuning subsystem before proceeding with lower level testing. Use the Reference Receiver Troubleshooting Procedure, Paragraph 8-C-131, to check signal level if the laser assembly and tuning circuits appear to be functioning properly. If the READY LED does not extinguish, spurious errors may be occurring on the reference frequency signal. Various internal and externA1 noise or interference may be responsible. Check A3 ground connections and Vcc coupling capacitors. Check that the 5518A cover is fastened securely. Marginal optical signal to the reference receiver may aggravate noise problems. Check for adequate signal according to Reference Receiver Troubleshooting, Paragraph 8-C-131. Improper system grounding may also cause noise problems, see Section II.

8-C-47. 5518A Assembly RemovA1 Instructions

8-C-48. Figure 8-C-10 shows the 5518A assembly locations. The exploded view diagram in Section VI provides access and removal information as well as assembly part number reference.

Reference Designator	Description
A1	Connector Board
A2	Receiver Board
A3	Controller/Reference Board
A4	Sampler Board
A5	High Voltage Power Supply
A6	Laser Assembly
A7	Sampler Assembly
A8	Straightness Mount

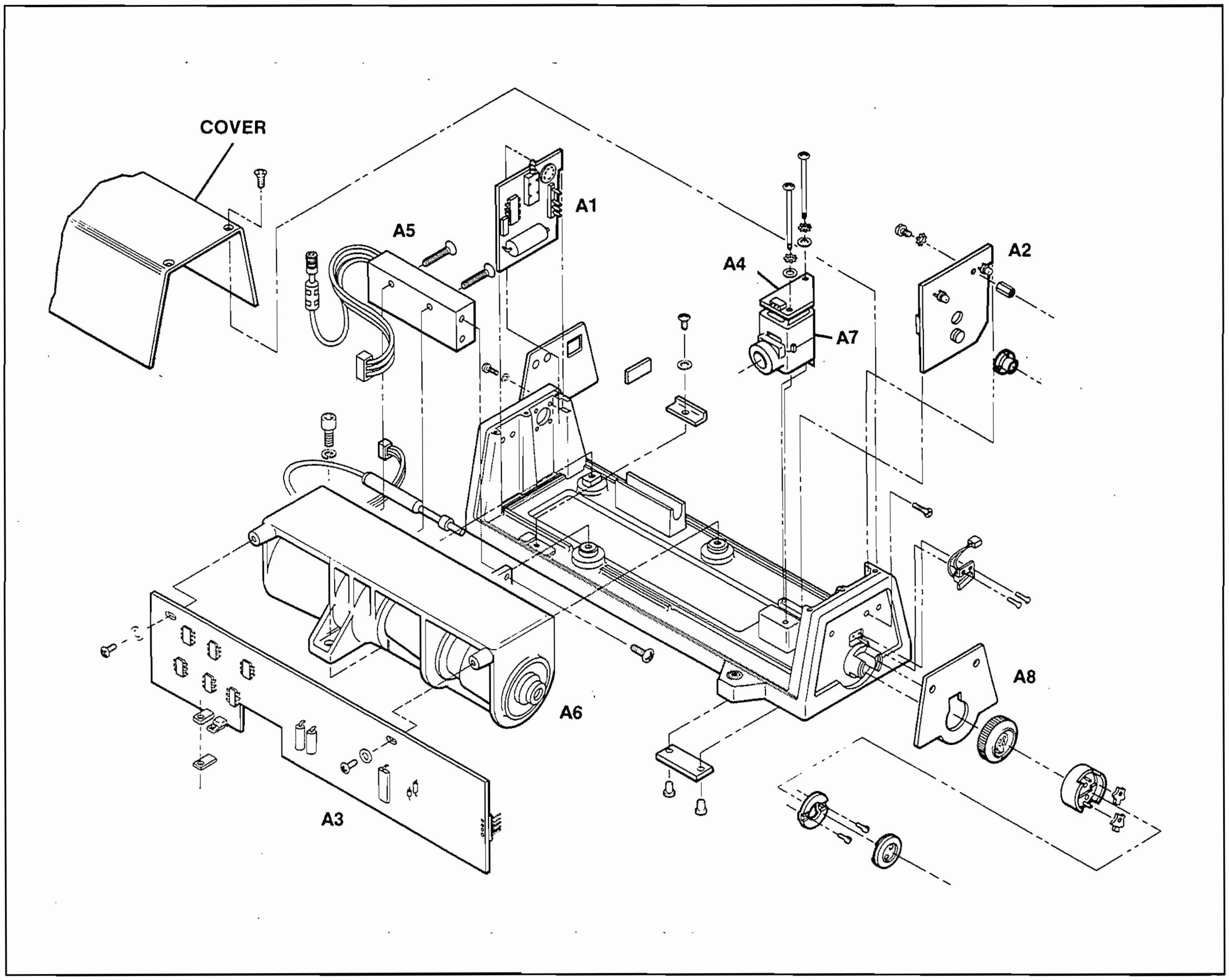


Figure 8-C-10. 5518A Assembly Designations

8-C-49. 5518A A1 CONNECTOR BOARD CIRCUIT THEORY

8-C-50. The Connector Board interconnects the main laser cable, laser tube heater, laser power supply, A3 Controller/ Reference Board and via A3, the A2 Receiver Board. The schematic diagram for A1 is shown in *Figure 8-C-12.*

8-C-51. Capacitors C1 through C4 serve to filter out noise on the power supply line. C4 filters current spikes created by the high voltage power supply. Diodes CR1 and CR2 provide transient protection. F1 protects the system against laser power supply failures. J4 is the connector for the laser tube heater and cathode. DS1 lights when the high voltage supply is powered. DS2 lights when the 5518A is ready for use. R3 is used to adjust laser current as per the adjustment procedures in Section IV.

8-C-52. 5518A A1 CONNECTOR BOARD TROUBLESHOOTING

WARNING: HIGH VOLTAGE IS PRESENT ON J4 IF THE LASER IS ON AND THE TUBE CONNECTOR IS NOT CONNECTED TO J4.

8-C-53. Use the schematic diagram *Figure 8-C-12,* an ohmmeter, and a voltmeter to troubleshoot A1. Check to see if F1 is blown. Check for proper transmission of power supply voltages. Check for proper diode action across CR1 and CR2. Check C1 through C5 for shorts. Check R3 and R4.

8-C-54. 5518A LASER HIGH VOLTAGE SECTION CIRCUIT THEORY

NOTE: Newer high-voltage power supplies have two input wires rather than 3. The white/orange wire has been deleted.

8-C-55. The high voltage supply (*Figure 8-C-11)* receives +15 Volts from the 5508A through A1F1. A1R3 and A1R4 set the supplies current limit. The laser's discharge current passes through the high-voltage connector to the laser anode and from the laser cathode to A1J4 pin 1 (see *Figure 8-C-11,* "High Voltage Wiring"). Never remove A1J4 with the high voltage supply on, dangerous high voltage exists.

8-C-56. The laser assembly consists of an aluminum housing, laser tube, magnets, telescope and the quarter-wave/half-wave plate assembly. The telescope expands and collimates the beam. The quarter-wave plate and half-wave plate establish orientation of the two laser beam components.

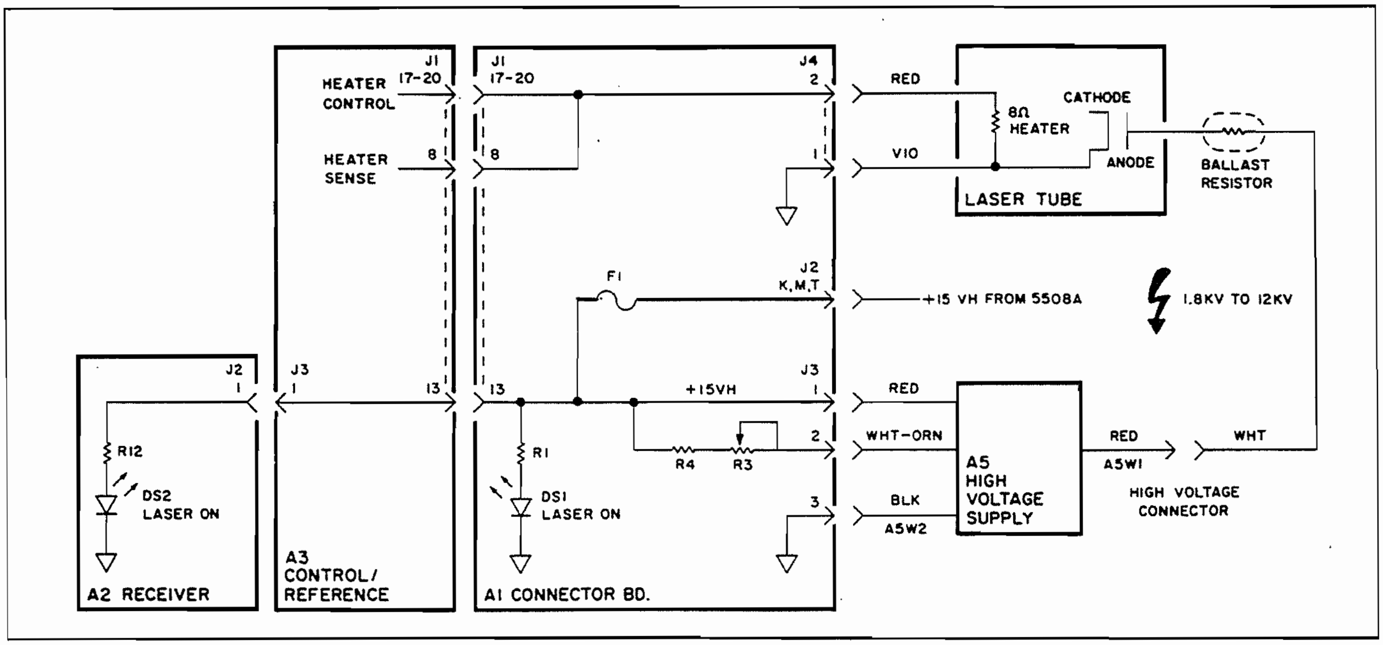

J1
HEATER CONTROL
17-20
HEATER SENSE
8
J1
17-20
8
J4
2
1
RED
VIO
CATHODE
8Ω HEATER
ANODE
LASER TUBE
BALLAST RESISTOR
F1
J2
K,M,T
+15 VH FROM 5508A
1.8KV TO 12KV
J2
1
J3
1
13
13
+15VH
J3
1
2
3
R4
R3
RED
WHT-ORN
BLK
A5W2
A5 HIGH VOLTAGE SUPPLY
RED
A5W1
WHT
HIGH VOLTAGE CONNECTOR
R12
DS2 LASER ON
A2 RECEIVER
A3 CONTROL/ REFERENCE
R1
DS1 LASER ON
A1 CONNECTOR BD.

Figure 8-C-11. Laser Assembly Wiring

8-C-57. HIGH VOLTAGE POWER SUPPLY TROUBLESHOOTING

WARNING

FROM 12 KILOVOLTS TO 1.8 KILOVOLTS DC IS PRESENT ON THE ANODE OF THE LASER TUBE IN THE 5518A. EXERCISE EXTERME CAUTION WHEN WORKING INSIDE THE INSTRUMENT. THE HIGH VOLTAGE COULD CAUSE SERIOUS PERSONAL INJUFY IF CONTACTED. ANY MAINTENANCE SHOULD BE BY SERVICE TRAINED PERSONNEL ONLY.

WARNING

NEVER REMOVE A1J4 WITH THE HGIH VOLTAGE SUPPLY ON. DANGEROUS HIGH VOLTAGE EXISTS.

Note

Newer high-voltage power supplies have two input wires rather than 3. The white/orange wire has been deleted.

8-C-58. Various conditions result from a faulty HV power supply.

a. NO LASER LIGHT is emitted. Check that F1 is not blown and that the voltage at F1 is +15V. Check the high voltage connector and A1J3 and A1J4. Turn the power off and disconnect the high voltage connector. Carefully connect a high voltage probe, (you will need to make a jumper to extend the probe into the high voltage connector), turn power back on, and perform an open circuit voltage test. The voltage should be 10kV to 12 kV. If not, replace the high voltage power supply. If the laser still doesn't work then replace the laser assembly.

WARNING

AFTER TESTING, THE POWER SUPPLY MAY TAKE UP TO 3 MINUTES FOR THE VOLTAGE TO DECAY.

b. Laser light is emitted but flashes or causes a REF Error. Turn power off and disconnect A1J4. Insert a 1K resistor (Rt) between the J4 pin 1 connector. (Leave J4 pin 2 disconnected). Connect an oscilloscope across Rt. Turn on the power and allow the laser to warm up. Observe the DC test voltage. It should be between 3 and 4 volts. If not, perform the current adjustment procedure in paragraph 5-22 of this manual. Set the scope to view the AC component and calculate the percent ripple. There should be less than 3% ripple in the test voltage. If not, replace the HV power supply. If the ballast resistor is bad the test voltage might be a nonperiodic intermittent voltage. If this is so, replace the laser tube assembly.

Note

If a power problem is intermittent, then sometimes a tap with a screwdriver will aggravate the problem for test purposes.

Note

If any part of the laser assembly is defective, replace entire assembly.

8-C-59. 5518A A2 MEASUREMENT RECEIVER AND 5518A TURRET SWITCH ASSEMBLY CIRCUIT THEORY

8-C-60. Paragraphs 8-C-61 through 8-C-68 contain circuit theory for the measurement receiver and the turret switch assemblies. Paragraphs 8-C-69 through 8-C-70 cover the troubleshooting information.

8-C-61. The measurement receiver (Figure 8-C-13) amplifies and converts the difference frequency of the laser beam to TTL levels and also supplies a signal to the 5508 that is proportional to the signal level of the difference frequency. The receiver circuit consists of photodiode CR3 and associated biasing; amplifier U1; a gain switching circuit Q1; and a transistor level shifter Q2.

8-C-62. R11 and C6 filter the +15 VC bias voltage used to reverse bias photodiode CR3. Reverse bias reduces the diode capacitance. Direct current from the photodiode flows into R7 while alternating current from the photodiode flows through C7 to U1.

8-C-63. U1 contains two amplifiers. The gain of the first amplifier is set by the resistance between pin 6 and pin 8. The second amplifier's gain is set by R3. Counterclockwise rotation of the adjustment screw of R3 results in increased gain. Calibration procedures for R3 are given in Section V. If the gain is too high, the duty cycle of the TTL output is distorted and the beam strength current folds back.

8-C-64. In normal operation, S1 of the turret switch assemby is open allowing Q1 to conduct. The gain of the first amplifier is determined by the parallel combination of R4 and R5. When the turret of the 5518A is set for a straightness measurement, S1 is closed, Q1 is off and the gain of the first amplifier is set by R4 only. C1, R1 and R2 filter +15 VC and -15V so that noise on these supplies is not fed through Q1 to the amplifiers.

8-C-65. At the output of the second amplifier of U1, a peak detector circuit charges C9 to the peak output voltage. With no current from the photodiode, the voltage on C9 is about 1.5V. When photodiode current is present, the change in voltage on C9 is the amplitude of the signal coming out of the second amplifier. The voltage at pin 13 changes the same amount. The current sunk into pin 12 (beam strength current) is the voltage at pin 13 divided by R8. R9 protects the IC from over voltages on the cable to the 5508A.

8-C-66. When the output signal from the second amplifier is 100 millivolts or more, the voltage at pin 2 drops to light LED DS1. DS1 lit indicates that there is sufficient signal to make a measurement.R6 limits the LED current to the proper value.

8-C-67. Level Shifter Q2, CR2 and R10 shift the output of U1 to TTL levels. Capacitors C2 through C5 and C8 are used for coupling and bypass. A TTL high on U1 pin 11 ($\overline{\text{LTO}}$ FALSE) gates off the TTL output and the beam strength current. $\overline{\text{LTO}}$, an output of the 5518A state machine, is true when the 5518A is ready for use.

8-C-68. DS2 lights when the supply for the high voltage supply is on, warning the user that the laser is powered. R12 limits the LED current.

8-C-69. 5518A A2 MEASUREMENT RECEIVER TROUBLESHOOTING

NOTE

Except when noted, all components are on A2 Receiver board.

8-C-70. There are three symptoms of measurement receiver problems:

a. If the 5508A displays PA Error, go to step d.

b. If the 5508A displays SL Error, go to step h.

c. If the 5508A makes measurements but the beam strength meter does not move, go to step y.

d. Set 5518A turret to OTHER with both shutters open. Wait for 5518A READY LED to stay on. Use a clean retroreflector (HP 10767A) to return the laser beam through the return aperture. Place optical filter (HP 1000-0598) in the beam from the retroreflector to the return aperture. (Do not let the beam between the exit aperture and the retroreflector hit the filter). Reset the 5508A. Does the 5508A display 0.00000? If yes, go to step e. If no, go to step f.

e. Measurement optics dirty or misaligned. See optics section or if a PA Error or SL Error displays on the 5508A when the turret is set to STRAIGHT, go to step x.

f. Remove the optical filter and rotate gain pot R3 fully counterclockwise (when the voltage on the outer lead of C2 no longer increases, R3 is set correctly). Again use the retroreflector to return the beam to the return aperture. Reset the 5508A. Does the 5508A display 0.00000? If yes, go to step g. If no, go to step i.

g. Check the measurement polarizer, the turret window and the photodiode lens (A2CR3) for cracks, dirt, or cloudiness. Set the gain of the measurement receiver according to the 5518A calibration procedure.

h. The measurement receiver may be oscillating or amplifying crosstalk from the reference receiver. Check all grounding and power supply decoupling of the measurement and reference receivers. Especially check the standoff between the A2 board and the instrument case. If everything is OK, go to step d.

i. Set 5518A to OTHER. Rotate R3 fully counterclockwise (voltage on outer lead of C2 should be about 0.7V). The READY LED should be lit and a TTL signal present at A3TP19 (if not see first step of reference receiver troubleshooting). Are TTL signals present at A3U18 pins 1 and 3? If yes, go to step j. If no, go to step k.

j. Is a 400 mV p-p signal of the same frequency as in step i at the SEL FREQ test point in the Measurement Freq Multiplier section of 5508A A3 board? If yes then the Beam block ($\overline{\text{MEAS}}$) or the LOL ERROR ($\overline{\text{MEAS}}$) lines on the 5508A A3 are defective. If not then the connections between 5518A A3 and 5508A A3 are bad or the measurement line receiver (U12 of 5508A A3) is bad.

k. Is DS1, the SIGNAL LED, lit? If yes, go to step l. If no, go to step n.

l. Is a TTL signal present at A3TP20? If yes, then replace A3L4 or A3U18. If no, go to step m.

m. Is there a 0.3V to 0.7V square wave at base of Q2? If no, replace Q2 or U1. If yes, replace Q2, CR2 or R10.

n. Set turret to STRAIGHT. Return the laser beam to the exit aperture using a plane mirror HP 10773A. Does DS1 light? If yes, then replace measurement polarizer. If no, go to step o.

o. Is U1 pin 2 <0.8V? If yes, then replace DS1 or R6. If no, go to step p.

p. U1 may be bad. Remove the plane mirror. Check voltages on U1 according to the table below:

Pin	Voltage	Possible Trouble
9, 14	+5V	Power Supply
1, 15	0	Ground
11	<0.4V	U1, $\overline{\text{LTO}}$ line open
8	0.7V	C7, R4, R5, Q1, U1
7	4.8V	C4, U1
6	0.7V	R3, C2, R4, R5, Q1, U1
5	2.3V	C3, U1
4	0.8V	C2, U1
10	1.6V	C9, U1
3	5V	U1
2	5V	R6, DS1, U1
12	5V	R9, meter drive in 5508A, U1
13	0V	R8, U1
16	0.7V	Q2, U1

NOTE

If any of the voltages are incorrect, check the listed faulty parts. If all are OK, go to step q.

q. Set turret to OTHER and insert a retroreflector. Does pin 10 voltage increase by >0.2V when the retroreflector shines the beam into the return aperture in the turret? If yes, replace C3 or U1. If no, go to step r.

r. Does voltage at CR3 - R7 node go from <0.02V to >1V when shining laser into return aperture? If yes, go to step u. If no, go to step s.

s. Is voltage at CR3 - R11 node approximately 15V? If no, replace R11, C6 or CR3. If yes, go to step t.

t. Check CR3, R7, and C7. Check return aperture for obstructions. Check measurement polarizer, turret window and CR3 for scratches , dirt, or cloudiness.

u. Does voltage at CR3 - R11 node decrease by >50 mV when the laser beam shines into return aperture? If no, replace R11, C6 or CR3. If yes, go to step v.

v. Shine laser into return aperture. Place the test polarizer (HP 1000-0616) in upper beam. The polarizer edge should make a 45° angle with the 5518A base. Attach DVM negative lead to A2TP1 (ground). When the polarizer is in the beam, the voltage at CR3-R7 node should be <1/10 the voltage when the polarizer is not there. The polarizer may have to be rotated 90° to get the low voltage. If this result is obtained go to step w. If not, replace the turret polarizer.

w. Does the drain to source resistance of Q1 go from <1 kohm to >30 kohm when the turret is set to STRAIGHT. If yes, replace U1, C2, or C7. If no, replace R4, R5, Q1, R13, R1, R2, C1 or straightness switch.

x. Replace the straightness mount. If the 5508A display still shows PA Error or SL Error only in straightness mode then check the straightness switch and its circuitry (R1, R2, R4, R5, R13, C1, Q1). The drain to source resistance of Q1 should go from <1 kohm to >30 kohm when the turret is set to STRAIGHT.

y. Set 5518A turret to OTHER. Wait for 5518A READY LED to stay on. Use a retroreflector (HP 10767A) to return the laser beam through the return aperture. Press RESET on 5508A. The 5508A display should read 0.00000. The beam strength meter should read greater than half way. If yes, everything is OK. If not, then block the beam and measure voltage at A3J3 pin 7 (the beam strength line). Is it 5V? If no then disconnect the 5518A from the 5508A meter drive circuit and check 5508A meter drive. If it is OK, then check the cabling or replace A2U1 or A2R9. If yes, go to step z.

z. Unblock the beam. The voltage at A3J3 pin 7 should drop from 5V. If it does, the 5518A is OK, check the 5508A. If it doesn't, check A2U1 or A2R9.

8-C-71. 5518A A3 CONTROLLER/REFERENCE BOARD AND A4 SAMPLER BOARD

8-C-72. Paragraphs 8-C-75 through 8-C-109 contain circuit theory for Assembly A3. Paragraphs 8-C-110 through 8-C-111 contain circuit theory for Assembly A4. Troubleshooting is covered in Paragraphs 8-C-112 through 8-C-131.

8-C-73. The schematic diagram for A3 and A4 is shown in Figure 8-C-14. The schematic has functional blocks that are labeled alphabetically with circled letters. These labels correspond to the circled letters in the text for the circuit theory.

8-C-74. Assemblies A3 and A4 contain the electronics for the following portions of the Laser Head Block Diagram:

a. Power Amplifier
b. Warm-up Error Amplifier
c. Photodiode and Amplifier
d. Liquid Crystal
e. Clock and State Machine
f. Subtracting Sample and Hold
g. Reference Receiver

8-C-75. 5518A A3 CONTROLLER/REFERENCE BOARD CIRCUIT THEORY

8-C-76. Clock Ⓐ

8-C-77. The frequency of oscillator U10 is determined by timing components R8, C7 and C8. For normal operation, C7 and C8 connect in parallel to give an output frequency of 100 Hz. For testing and signature analysis purposes, the oscillator can be configured to run at 20 kHz by moving the HTROK jumper JMP4 from the NORM position to the HI position. This removes C7 from the oscillator circuit.

8-C-78. Dividers Ⓑ

8-C-79. The dividers, consistng of U4A and U6, convert the 100 Hz oscillator signal into the desired periods. The first stage of the divider, U6 a dual 4-bit counter, divides the 100 Hz by 256. The last output of U6 at pin 8 has a period of 2.56 seconds (nominal). The output of U4A at pin 13 has a period of 5.12 seconds while the output at pin 9 provides a period of 25.6 seconds. These two outputs are ANDed by U2C to produce a signal called DISABLE which is high 2.56 seconds out of every 25.6 seconds. Both the subtracting sample and hold circuit and the power amplifier use the DISABLE signal.

8-C-80. State Machine Ⓕ

8-C-81. The state machine, consisting of U3, U4B, and U8A, determines the four states of controller operation. The warm-up mode consists of two states, preheat and heater qualified. The optical mode has two states, locking and locked (see Figure 8-C-2, State Diagram for State Machine). The following paragraphs describe the sequence from preheat to locked.

8-C-82. Upon power-up, the power-on reset circuit places the state machine in the preheat state and the power amplifier turns the heater full on. U8A samples the HTR OK signal on the falling edge of DISABLE to allow sufficient time for the heater coil to cool to the rod temperature. See Figure 8-C-4, Warm-up Mode Timing Diagram. When the heater temperature rises to the proper value, the HTR OK signal from U15 causes the output of U8A, HTRQ, to go high. The state machine enters the heater qualified state and the READY LED blinks approximately once per second. The rate of blinking is determined by the output of U6B which is gated through U2A and U19C to the READY LED. Blinking continues until the state machine enters the locked state.

8-C-83. When HTRQ goes true, U4B changes states from reset to count. Unless reset by HTR OK dropping low, U4B counts for 100 seconds and then clocks U3A. This sets OPTICAL high and locks HTRQ on. The 100 second period is sufficent to stabilize the heater temperature.

8-C-84. When OPTICAL goes high, the state machine enters the locking state and optical feedback controls the heater. After this state has been held for 50 seconds LTO (U1F, pin 12) goes high and the controller enters the locked state. If REFON (a signal from the Reference Receiver) is not high, the entire circuit will be reset by the Power-On-Reset circuit. Otherwise U1F and U19E turn on the READY indicator LED indicating that the 5518A is ready for use.

8-C-85. Liquid Crystal Ⓓ

8-C-86. The liquid crystal, which is mounted on A4, connects to CMOS driver U8B via conductive rubber strips. When the PASSIVE/$\overline{\text{ACTIVE}}$ signal at U6B pin 8 is high, both outputs of U8B are high, thereby placing zero potential across the LC. This is the passive state of the LC and causes the laser beam polarization to rotate by 90°

8-C-87. When PASSIVE/$\overline{\text{ACTIVE}}$ is low, U8B produces a 50 Hz, symmetrical square wave output to configure the LC in the active state. During this state, the LC does NOT rotate the laser beam polarizations.

8-C-88. Photodiode and Amplifier Ⓔ

8-C-89. The polarizing filter, which lies between the LC and the photodiode (CR1 of A4), allows only one of the two orthogonal components of the laser beam to strike the photodiode. During the passive state of the LC, the polarizing filter blocks the vertical component and the photodiode current is proportional to the horizontal component. During the active state, the photodiode current is proportional to the vertical component. The output of U11D at TP16 equals the photodiode current multiplied by an effective resistance of:

$$\frac{(R20 + R22)\ R17}{R20}$$

8-C-90. Warm-up Error Amplifier and Comparator Ⓙ

8-C-91. The resistance of the heater increases with increases of temperature. This effect is used in the circuit formed by R9, the laser tube heater, R16, R18, and R19 to generate an error signal on the order of 1 mV/°C. Warm-up error amplifier U14 amplifies the error signal and drives U15.

8-C-92. The output of the HTR OK comparator, U15, goes high when the error voltage nears zero. The temperature at which HTR OK occurs is set by potentiometer R16 as described in the Reference Temperature Adjustment in Section V.

8-C-93. Subtracting Sample and Hold Ⓗ

8-C-94. During warm-up mode, U19B disables the heater for 2.56 seconds out of every 25.6 seconds. During the 2.56 second disable, the heater temperature stabilizes and U12B samples the output of U14. When U12B opens, the sampled voltage is held on C13 and buffered by U11B. Switch U12C connects C14 and the input of U11C to ground.

8-C-95. During the optical mode, U11D alternately drives one of the sample and hold circuits then the other. The sample and hold circuit consisting of U12D, C14, and U11C, provides a signal that is proportional to the horizontal component. The other sample and hold circuit, U12A, C13, and U11B is used for the vertical component.

8-C-96. The first counter, U6, in the divider section controls the liquid crystal and the sample and hold circuits. A sample and hold is performed once per cycle of T1.28, alternating between the vertical and horizontal components. Thus each component is sampled once every 2.56 seconds. This is shown in Figure 8-C-7, Optical Mode Timing. The LC is allowed to stabilize for 0.64 seconds before the switch to the sample and hold is closed. The hold cycle begins when the switch opens at the end of a cycle of T1.28 and at the end of a half cycle of PASSIVE. The present half cycle of PASSIVE/$\overline{\text{ACTIVE}}$ determines which component is sampled. Op-amp U11A computes the difference between the two sample and holds.

8-C-97. Power Amplifier Ⓘ

8-C-98. The output of U11A drives the power amplifier which in turn drives the laser tube heater. The frequency response of the power amplifier is determined by the input filter (R31, R27 and C18) and the nonlinear feedback for op-amp U13 (R32, R33, R39, R40, R41, C20, CR3 and CR4).

8-C-99. Q5 provides level shifting to drive the base of the Darlington power transistor Q3. U19B disables the output stage by grounding the base of Q5 when the heater error voltage is sampled during the warm-up mode.

8-C-100. Reference Receiver Ⓛ

8-C-101. The reference receiver consists of diode CR5, an amplifier U17, and a transistor level shifter Q6. The receiver amplifies and converts the sinsoidal output from CR5 to TTL levels. When $\overline{\text{LTO}}$ goes low, and the received signal has an adequate signal to noise ratio, the receiver is enabled and provides a low TTL signal $\overline{\text{REFON}}$. During the warm-up and locking modes, the receiver supplies no useful information and is therefore disabled.

8-C-102. CR5 is reverse biased to reduce capacitance. The +15V bias voltage is filtered by R46 and C27. The photodiode's dc component flows into R47 while the path for ac is through C25 to U17. A polarizer oriented at 45° to both laser frequency components passes optical power at the reference frequency onto CR5. The reference frequency is the difference in frequency between the 2 optical frequency components of the laser beam.

8-C-103. U17 contains two amplifiers. The gain of the first amplifier is set by R44. R42 and R43 set the gain of the second amplifier. A peak detector circuit charges C28 to the peak level of the linear output of U17. With no current from the photodiode, the voltage on C28 is about 1.5V. When photodiode current is present, the change in voltage on C28 is the amplitude of the signal coming out of the second amplifier. When the amplitude exceeds 100 mV, the voltage at pin 2 ($\overline{\text{REFON}}$) drops to TTL low. Q6, CR6 and R45 shift the output of U17 to TTL levels. C22, C23, C24, C26 and C29 are used for coupling and bypass. A TTL high on pin 11 gates off the TTL output and raises pin 2 to TTL high.

8-C-104. Line Drivers Ⓚ

8-C-105. U16 and U18 provide the necessary power to send the Measurement and Reference Frequency Signals to the 5508A. L3 and L4 limit the current spikes in U16 and U18. The special grounding and decoupling of the line drivers and receivers prevent crosstalk and oscillations.

8-C-106. Power-On Reset (POR) Ⓖ

8-C-107. When power is turned on, or REFON drops low during the locked state of optical mode, the power-on reset circuit sets the state machine to the preheat state.

8-C-108. Power

8-C-109. +15 VD and -15V are supplied by the 5508A. +5V is generated by U7. CR2 protects U7. C5 stabilizes U7 and C4 filters U7 output. +15 VC is the +15 VD supply after it has been filtered by L2 and C11. L1 and C12 filter -15V. C2, 3, 6, 16, 17, 21, provide local decoupling of the supplies.

8-C-110. 5518A A4 SAMPLER BOARD CIRCUIT THEORY

8-C-111. The Sampler board connects to Controller/Reference board A3. The only active component on A4 is A4CR1, a photodiode that provides a signal to U11D on A3. Pads on the underside of A4 connect to the liquid crystal via elastomeric connector strips which project from the sampler assembly. Liquid crystal operation is discussed in the A3 theory section.

8-C-112. 5518A A3 CONTROLLER/REFERENCE BOARD TROUBLESHOOTING

8-C-113. Service for A3 is divided into the following procedures:

a. Digital
b. Photodiode and amplifier
c. Liquid crystal
d. Subtracting sample and hold
e. Power amplifier
f. Warm-up error amplifier
g. Power supplies
h. Reference receiver

8-C-114. Consult Paragraph 8-C-43, 5518A System Level Troubleshooting, to determine which procedure should be used.

8-C-115. Standard Troubleshooting Procedures

8-C-116. In the following tests, reference is frequently made to "localize the defective element by standard troubleshooting procedures". This consists of the following:

a. The test procedure places a group of IC's in a definite state and:
   1. provides the correct values of the input and output signals characteristics
      OR
   2. implies use of the schematic to determine the signal characteristics
      OR
   3. simply states a suspected component
b. When the test procedure specifies a suspected component, replace it and run the test again.
c. When signal characteristics are known, measure the signals until a component is found that has correct inputs but erroneous outputs. Most likely this component is defective. If not, check for:
   1. output loading such as a board short
   2. shorted input on a downstream circuit

   If inputs are incorrect, check for open traces and faulty outputs from previous stages.
d. If an erroneous signal comes from another board, perform the test procedure for the suspected board.

8-C-117. Digital Troubleshooting

8-C-118. This procedure covers the clock, dividers, power-on-reset, and state machine blocks of the A3 board. The procedure assumes that the power supplies are functioning properly. The procedure requires use of standard troubleshooting procedures which are outlines in Paragraph 8-116.

8-C-119. Troubleshooting Strategy: Signature analysis is used in this section to isolate faulty digital components. Malfunctions in the clock, dividers, or power-on-reset blocks will not allow the signature analyzer to operate properly. Proper clock operation is verified first, then an attempt at verifying the state machine using signature analysis is made. If the signature analyzer doesn't work the dividers and resets must be repaired and then the state machine can be verified.

NOTE

> Upon successful completion of a check, unless otherwise specified, return jumpers to original position.

a. Turn power on. Position all jumpers to the left. Measure clock frequency at TP5 (CLOCK). If it is 100 Hz ±20% go to step b. If not, check clock section components.

b. Move HTROK jumper to HI. If clock frequency is now 75 kHz ±20%, go to step c. If not, check C8.

c. Keep HTROK in HI. Set REFON jumper to HI. Set up signature analysis clock, start, and stop signals for falling edge detection as indicated in the lower center portion of A3. Take signatures on XU9.

pin 16 (+5V Test Signature 104C pin 2 5653
pin 3 2333
pin 5 3357
pin 7 HP8P
pin 10 U729
pin 11 6PCP
pin 12 0148
pin 13 A10H

Check signature of U19, pin 10 = A957

If these are OK, go to step m.

If the signature analyzer will not take signatures, then there is malfunction in the dividers or power-on-reset sections, go to step d.

If the signature analyzer works, but one or more signatures are wrong, go to step e.

d. Set HTROK to HI, REFON to HI, and RESET to TEST. Connect TP2, TP3, and pin X of HTROK jumper to ground (TP1 or TP18). Verify the dividers by measuring the frequencies at the following IC pins and determine that they are equal to the indicated ratios, i.e., the frequency at U6 pin 13 should be equal to the frequency at TP5 divided by 16. Note: The counter function of the signature analyzer may not work so a dedicated counter might be needed.

Measure Frequency at		**Frequency Should be**	**If Incorrect**
IC	Pin	Equal Ratio of	Faulty Part is:
U6	13 =	F(TP5/16) or ~4.8 kHz)	U6
U4	15 =	F(U6 pin 13/16 or ~300 Hz)	U4 or U6
U4	1 =	F(U4 pin 15/10) or ~30 Hz	U4
U4	7 =	F(U4 pin 1/10) or ~3 Hz	U4

If no problem is found, proceed to step e.

e. Set HTROK to HI, REFON to HI, RESET to TEST. Connect TP2, TP3, and pin X of HTROK jumper to ground. (TP1 or TP18). Set up the signature analysis clock, start, and stop signals for falling edge detection. Using the signatures listed in step s, localize the defective element by using standard signature analysis troubleshooting. Use the schematic to trace back faulty signals. Check U1 pin 6, U19 pin 10, and U2 pin 6 right away, they are critical points. If no trouble is found, go to step f.

f. Remove ground connection on HTROK jumper. Is U8, pin 6 signature FP96? If not, U8A or R48B is faulty. If so, go to step g, or see Warm-Up Error Amplifier Troubleshooting.

g. Remove the ground connection on TP3 and leave off. Is the +5V signature (TP9) = CP5P? If not, go to step h. If so, go to step j.

h. Set HTROK to LO. Is U8 pin 1 low? if not, U8 is bad. If yes, go to i.

i. Is TP3 high? If yes, go to j. If no, check U4B, U5D, U19D, R5D.

j. Remove ground connection on TP2 and leave off. Set HTROK to HI. Is +5V signature = AF7A? If yes, go to step m. If no, go to step k.

k. Remove RESET jumper. Tie center pin to +5V. Is TP2 high? If not, replace U19 or R5B. If so, go to step l.

1. With settings same as step k, check that U4 pins 1, 2, 9, 12, 13, and 16 are all high. If not, U4 is bad. At this point, the digital section should be OK.

m. Set REFON to HI, HTROK to X, all other jumpers to left. U8 pin 5 should be high. If not, check U8A. If so, go to step n.

n. Keep REFON to HI, set HTROK to LO. U8 pin 15 should be low. If not, U8A is bad. If so, go to step o.

o. Set REFON to LO. U9, pin 9 should be low. If not, U2B is bad. If so, go to step p.

p. Turn the power off. Set REFON to HI, HTROK to HI. Check that U1, pin 5 comes on then blinks at a few Hz or so at power on. If OK, go to step q. If not, replace C1 and check CR1, R5A, R51, and R48A.

q. Turn power off. Set REFON to HI. Set POWER AMP jumper to UP. Turn power on and allow the laser to run for five minutes. Observe the voltages at U19 pins 3 and 4. Pin 3 will be mostly at a TTL low but will periodically go high for a few seconds. Pin 4 should be at a voltage of at least 10V when pin 3 is low and should immediately go low when pin 3 goes high. If this is the case, then return all jumpers to the right, the Digital Section is OK. If pin 4 doesn't go low when pin 3 goes high, replace U19. If pin 4 doesn't reach at least 10V when pin 3 is low, see A3 Power Amp section.

r. Signature Analysis Signatures

Conditions for signature analysis:

HTROK = HI, REFON = HI, RESET = TEST;
TP2, TP3, and pin X of HTROK jumper to ground.

Pin	**U1**	**U2**	**U3**	**U4**	**U5**	**U6**	**U8**	**U19**
1	X	4UHP	CCPC	6678	4CCA	41A5	CCPC	F9C3
2	X	7U30	41A5	0000	FP96	0000	UA4P	X
3	X	41A5	FP96	8A5F	P861	FO9F	27HH	7130
4	F9C3	4A39	41A5	0000	4UHP	CU8C	UA4P	X
5	UA4P	CCPC	FP96	2OH3	P861	267H	41A5	961P
6	CCPC	961P	8U33	FP96	4H86	9CHA	0000	PC06
7	0000	0000	0000	UA4P	0000	0000	0000	0000
8	27HH	7130	3P95	0000	CCPC	4UHP	4UHP	0000
9	6678	8U33	7U30	6678	CCPC	4CCA	CC8F	CCPC
10	OP7C	6678	41A5	AOHO	CCPC	4A39	4UHP	PC06
11	4UHP	538U	20H3	88F5	A5P7	FF57	41A5	7U30
12	7U30	F9C3	FP96	0000	P861	0000	CC8F	0000
13	3P95	41A5	CCPC	538U	OP7C	9CHA	C5U7	CCPC
14	41A5	41A5	41A5	0000	41A5	41A5	41A5	41A5
15	X	X	X	4UHP	X	X	X	X
16	X	X	X	41A5	X	X	X	X

8-C-120. Photodiode and Amplifier Troubleshooting

8-C-121. The procedure assumes that the power supplies are functioning properly. Use a dedicated digital voltmeter, not the signature analyzer voltmeter function.

a. Set HTROK jumper to LO, PHOTODIODE jumper to TEST, liquid crystal jumper to PASS. Is voltage at TP16 more negative than -4V? If no, go to step c. If yes, go to step b.

b. Set LIQUID CRYSTAL jumper to ACT. Is voltage at TP16 more positive than -1 V? If no, go to step c. If yes, go to step d.

c. Verify U11 pin 13 is 0 V ±10 mV. If not, replace U11. Verify voltage at TP16 is 6/11 of that at U11D pin 14 and voltage at junction of R20 - R22 is 1/11 of that at U11D pin 14. If not, check R6, R17, R20, R22, and R24. Also U12A or U12D may be incorrectly loading this node.

d. Amplifier is OK. Check photodiode. Verify laser is on. Set photodiode jumper to NORM. Measure TP16 voltage. If it is >±0.5 V then photodiode. A4CR1 is good. If it is ≅6V then either the photodiode is shorted or U11 is bad. If it is -0.5V to +0.5V go to step e.

e. Remove photodiode jumper (A3JMP5) and check for diode action between the left hand pin of the jumper and ground. If no diode action is observed, replace A4CR1. Otherwise, not enough light is reaching the photodiode. Remote the sampler assembly and inspect the liquid crystal, beam splitters and A4CR1 for dirt, scratches, etc. If OK, see Liquid Crystal Troubleshooting.

8-C-122. Liquid Crystal Troubleshooting

8-C-123 This procedure assumes the digital circuits and photodiode and amplifier circuit are functioning properly.

a. Verify laser is on. Set all jumpers on A3 to left except liquid crystal to PASS. Insert test polarizer (HP P/N 1000-0616) between laser assembly and sampler assembly. The bottom edge of the polarizer should be parallel to the base of the 5518A. Measure TP16 voltage. Is it <0.2V? If yes, go to step c. If not, go to step b.

b. Rotate polarizer 90°. Is TP16 voltage <0.2V? If yes, go to step c. If no, go to step f.

c. Rotate polarizer 90°. Is TP16 voltage <0.5V? If yes, go to step c. If no, go to step f.

d. Set Liquid Crystal jumper to ACT. Is TP16 voltage <0.2V? If yes, go to step e. If not, go to step f.

e. Rotate polarizer 90°. Is TP16 voltage >0.5V? If yes, the liquid crystal is OK. If no, go to step f.

f. Liquid crystal may not be working. See Paragraph 8-C-40, Liquid Crystal Test. Check that the elastomeric connectors are connecting A4 and liquid crystal.

NOTE

The older HIP 5518A's have the black conducting rubber strips instead of the pink elastomeric connectors. The conducive rubber strips were found to develop bad contacts at A4 and the liquid crystal. If this problem develops, clean both sets of contacts with isopropyl alcohol and install the elastomeric connectors (HP part number 8160-0530).

8-C-124. Subtracting Sample and Hold Troubleshooting

8-C-125. This procedure assumes the digital circuit and photodiode and amplifier are functioning properly.

a. Set $\overline{\text{REFON}}$ jumper to LO, set HTROK to HI. Wait for READY LED to remain on. Set HTROK to NORM. Set photodiode jumper to TEST, set LIQUID CRYSTAL jumper to ACT. Using a dedicated dc voltmeter, check that the voltage at TP16 is -50 mV to +50 mV? If yes, go to step c. If no, go to step b.

b. The circuitry connected to pin 2 or pin 15 of U12 is incorrectly loading photodiode amp when switch U12A or U12D is closed. Check U11, C13, and C14.

c. Is voltage at TP13 equal to voltage at TP16 within 10 mV? If no, go to step d. If yes, go to step e.

d. Verify U12 pin 8 is low. Measure voltage from U11B pin 5 to TP13. Is it -10 mV to +10 mV? If yes, go to step i. If no, U11B is defective or its output is incorrectly loaded.

e. Is voltage at TP14 equal to voltage at TP16 within 10 mV. If yes, go to step g. If no, go to step f.

f. Verify U12 pin 9 is low. Measure voltage from U11C, pin 10 to TP14. Is it -10 mV to +10 mV? If yes, go to step i. If no, U11C is defective or its output is incorrectly loaded.

g. Set POWER AMP jumper to UP. Is voltage at TP12 between-20 mV and +20 mV? If yes, go to step i. If no, go to step h.

h. Verify U11A pin 3 voltage is about 1/2 of TP13 voltage. Verify U11A pin 2 voltage = U11A pin 3 voltage. If not, U11A, R10, R12, R14, or R15 may be bad.

i. Place liquid crystal jumper to NORM. TP16 will alternate between about 0V to about -5V. Record these voltages (the ΔV function of the HP 5005A is useful here). Measure voltage at TP13. It should be the same 0V reading as at TP16, within 20 mV. If OK, go to step k. If not, go to step j.

j. Measure the voltage on C13. During and just after the switch (U12A) is closed (delayed active signal on U5 pin 11), the voltage should equal the approximate zero voltage at TP16. If it is not, or if the voltage rapidly goes to zero, then C13 is shorted or the switch U12A does not work. Also check that U12B is open and U11B is not shorting this node.

k. Is the voltage at TP14 within 20 mV of the approximate -5V voltage at TP16. If yes, go to step m. If not, go to step l.

l. Measure the voltage on C14. During and just after the switch, U12D, is closed (Delayed Passive signal on U5, pin 6), the voltage should equal the approximate -5V at TP16. If it is not, or the voltage rapidly goes to zero, then C14 is shorted or U12D is faulty. Also check that U12C is open and U11C is not, shorting this node.

m. Set PHOTODIODE jumper to TEST, LIQUID CRYSTAL to PASS, POWER AMP to UP. Verify TP16 voltage is approximately -5V. Measure voltage at TP14, record this as V14. Measure voltage at U11A pin 3, record this as V3. Measure voltage at TP12. Is it equal to [2 × V3] -V14 within 30 mV? If yes, go to step o. If no, go to step n.

n. Verify U11A pin 2 is at the same voltage as U11A pin 3. If not, U11A or R15 is bad. Also check R14, R10, and R11.

o. The procedure thus far has shown that the subtracting sample and hold works during optical mode. Next the operation during warm-up is checked. Turn 5508A off. Move all A3 jumpers to NORM except $\overline{\text{REFON}}$ to HI. Connect an ohmmeter between pin 6 and 7 of U12B. Turn 5508A on. Meter should read open circuit when the DISABLE signal (U2, pin 8) is low. Meter should read less than 250 ohms when DISABLE is high. (The HP 5005A measures ohms to ground so pin 6 or pin 7 of U12B will have to be grounded for this test). If the result is satisfactory, go to step p. If not, U12B is defective.

p. Connect an ohmmeter between U12 pin 10 and ground. Ohmmeter should read less than 250 ohms while OPTICAL (U3, pin 5) is low. If it does, go to step q. If not, U12C is faulty.

8-C-126. Power Amplifier Troubleshooting

a. Set HTROK jumper to HI, $\overline{\text{REFON}}$ to LO and wait for READY LED to stay on. Set POWER AMP jumper to UP. Remove HEATER jumper. Is voltage at U13 pin 3 approximately 0.1V? If not, check R27, R31, R49, R50, R51, C18, and U13. If so, go to step b.

b. Within 3 minutes of setting POWER AMP to UP, is the voltage at TP11 >13V. If yes, go to step d. If not, go to step c.

c. Is U13 pin 6 >13V. If yes, go to step j. If no, replace R33 or U13.

d. Set Power Amplifier jumper to DOWN. Is voltage at TP 11 <0.6V within 3 minutes? If yes, go to step g. If no, go to step e.

e. Is U13 pin 6 ≤10V? If yes, go to step l. If no, go to step f.

f. Is U13 pin 3 approximately -0.1V? If yes, check R33 or U13. If no, check R49, R50, R51, U13.

g. While observing voltage at TP11, move POWER AMP jumper from DOWN to UP. TP11 voltage should jump to about 5V and then ramp up 0.1 V/second. If OK, go to step h. If the jump is >5.7V then either R32, R40, C20, or CR3 is open; or R33 is shorted; or check R49, R50, or R51. If the jump is >4.5V then either R32, R40, R41, CR3 or CR4 is shorted; or R39 is open; or check R49, R50, R51. If the ramping is too slow or too fast, then check R33, R49, R50, R51 and C20. If OK, go to step h.

h. When TP11 voltage is >13V, measure voltage from TP11 to TP17. If it is 5.7V to 6.7V, go to step i. If it is >6.7V, then CR4 is open. If it is <5.7V, then either R40, R41, or CR4 is shorted; or R39 is open.

i. Set HEATER jumper to OFF. Voltage at TP11 should be 0.2V to 0.6V. If so, the power amp is OK. If it is <0.2V, R9 is open.

j. Set POWER AMP to UP, HEATER jumper to NORM. Wait for U13 pin 6 to be >13V. Measure voltage at Q5 base. If it is >1V, go to step k. If it is >1V, R36 may be open.

k. Measure voltage across R37. If it is zero, then Q5 or R38 is open. If it is greater than 1V then C20, heater, or R39 is shorted; or Q3 or R33 is open; or check R21 and U14 loading this node; or Q3 is bad.

l. Set POWER AMP jumper to DOWN. Wait for U13 pin 6 to be ≤10V. Measure voltage at Q5 base. If it is >1V, then Q5 is shorted. If it is <1V, go to step m.

m. Measure voltage across R37. If it is >1V, then Q5 is shorted or R37 open. If it is zero, then Q3 or R9 is shorted or the heater is open.

8-C-127. Warm-Up Error Amplifier Troubleshooting

8-C-128. This procedure assumes the power amplifier is functioning properly.

a. Set HEATER jumper to OFF. Is TP11 voltage 0.2V to 0.6V? If yes, go to step b. If no, go to power amplifier servicing.

b. Is TP15 voltage 0.2V to 0.6V? If yes, go to step c. If no, R18, R19 or U14 is faulty.

c. Check R16 to see if it is shorted. Short TP15 to TP11. Measure U14 pin 6. Does the voltage stabilize between -1.5V and +1.5V? If yes, go to step d. If no, R21, R23 or U14 is faulty.

d. Remove TP15 to TP11 short and short TP15 to ground (TP18). Is U14 pin 6 voltage more negative than -12V? If yes, go to step e. If no, U14 is faulty.

e. Is voltage at U15 pin 3 half of U14 pin 6 voltage? If yes, go to step f. If no, R25, R26, U12 or U15 is faulty.

f. Is voltage at U15 pin 2 between 1.2V and 1.3V? If yes, go to step g. If no, R28, R29, R30 or U15 is faulty.

g. Is U15 pin 7 >3V? If yes, go to step h. If no, R5F, R48C, U8A or U15 is bad.

h. Remove TP15 short and short TP11 to ground. Is U14 pin 6 voltage >12V? If yes, go to step i. If not, U14 is bad.

i. Is U15 pin 7 between 0.10 and 0.20? If yes, the warm-up error amplifier is OK. If no, R5F, R48C, U8A or U15C is faulty.

8-C-129. Power Supplies Troubleshooting

8-C-130. If the correct voltage is not observed on A3TP8, 9, or 10 typical power supply troubleshooting should be followed. Following are suggested points to check:

a. Power comes from the HP 63312F Power Supply.

b. A1CR1 is in series with the -15V line.

c. A3L1 and A3L2 are in series with the power supplies.

d. There should be >200 ohms from +15V to ground.

e. If F1 blows, check for open in A1R3, A1R4 or middle lead of A1J3 open, or excessive current to High Voltage power supply. (See High Voltage Power Supply Troubleshooting in Paragraph 8-54.

f. Power supply components are on A1 and A3.

8-C-131. Reference Receiver Troubleshooting

a. With power removed from the 5518A set the REFON jumper on A3 to LO and HTROK to HI. Turn the 5518A power on. Does the READY LED eventually start blinking then remain on continuously? If no, see 5518A Trouble Isolation Procedure, Paragraph 8-35 and procedures recommended therein.

b. Are TTL level signals present at A3U16 pins 1 and 3 at a frequency between 1.5 and 2.0 MHz? If so the reference receiver may be working properly. If not, trace the signal path from U17 pin 16 to U16 pins 5, 6, and 7 (TP19) and check for the following:

U17 pin 16: 0.3- to 0.7-volt square wave at the
REFERENCE FREQUENCY,1.5 to 2.0 MHz.

TP19: TTL level square wave at the REFERENCE
FREQUENCY, 1.5 to 2.0 MHz.

If there is no activity found check U17 pin 2. If pin 2 is at a TTL high level or changing states then either the laser is not tuned properly, or the Reference Receiver is failing or not receiving adequate signal. Verify laser tuning according to step c before continuing with step d. If U17 pin 2 is at a TTL low level and there is no output activity as described above then U17 may be bad or it's output may be shorted. Go to step d.

c. Align a 10780A receiver so that the laser output beam is incident on the photodiode lens. If the laser is properly tuned, the LED on top of the 10780A should light and the 10780A should output a square wave at the REFERENCE FREQUENCY. This test can be performed with the laser installed using one of the axes' receivers. In this case, if the axis interferometer is installed, vibration, etc. will modulate the REFERENCE FREQUENCY but a frequency in the range of 1.5 to 2.0 MHz should still be apparent. If no steady REFERENCE FREQUENCY signal is detected by the 10780A then a laser tuning failure is indicated which is independent of the Reference Receiver. See 5518A Trouble Isolation Procedure, Paragraph 8-35. Otherwise proceed with step d.

d. Measure and record the dc voltages at U17 pin 10 and the CR5-R46 node. With REFON jumper still set to LO, place a piece of paper between the laser assembly and the sampler assembly to block the laser beam. The voltage at U17 pin 10 should drop by 250 mV or more, indicating adequate signal, and the following dc voltages should be measured on the pins of U17 with the beam blocked:

PIN	DC VOLTAGE	POSSIBLE TROUBLE
9,12,14	V_{CC}	Power Supply
1,15	gnd	Ground
11	TTL HIGH	U17, U3B, Digital Circuits
8	0.7V ±0.1	R44, U17
7	4.8V ±0.1	C22, U17
6	0.7V ±0.1	R43, R44, C23, U17
5	2.3V ±0.2	C24, U17
4	0.8V ±0.1	C23, U17
10	1.6V ±0.2	C28, U17
3	V_{CC} +0/−0.1	U17
2	V_{CC} +0/−0.1	U17
13	<80 mV	U17
16	0.7V ±0.1	Q6, U17

If any voltage is incorrect, check or replace the listed part.

If the voltage at pin 10 does not drop according to the above, measure the dc voltage at the CR5-R46 node with the beam blocked. It should be approximately 15 volts and should have increased at least 6 mV above the value measured and recorded previously when the laser beam was unblocked. If not check R46, C27, or CR5. CR5 can be checked by removing power from the 5518A and checking for diode action of CR5 using a dc ohmmeter. Resistance measured in the reverse direction should be much larger than the resistance measured in the forward direction. If CR5 is OK replace U17.

e. In cases of marginal signal strength the following factors should be checked:

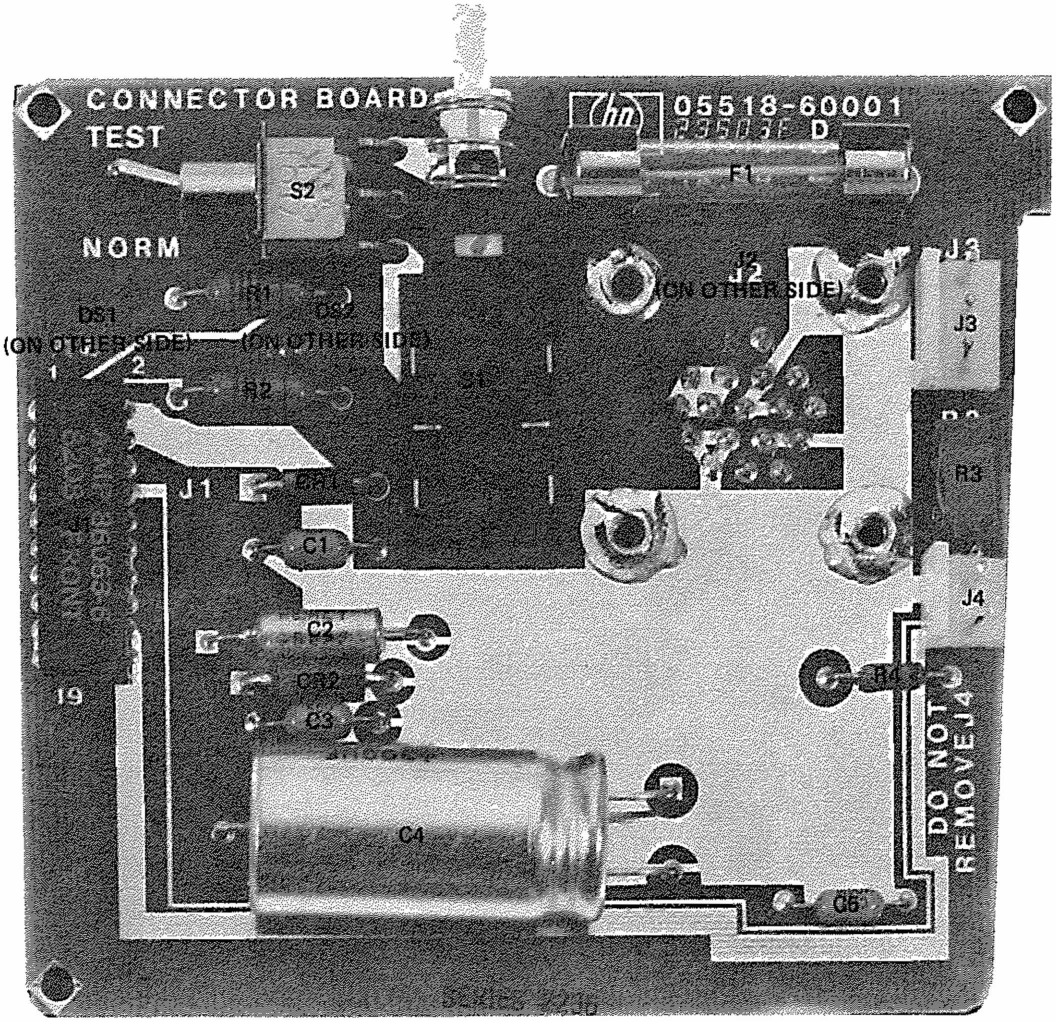
Laser assembly output power.

Sampler assembly function.

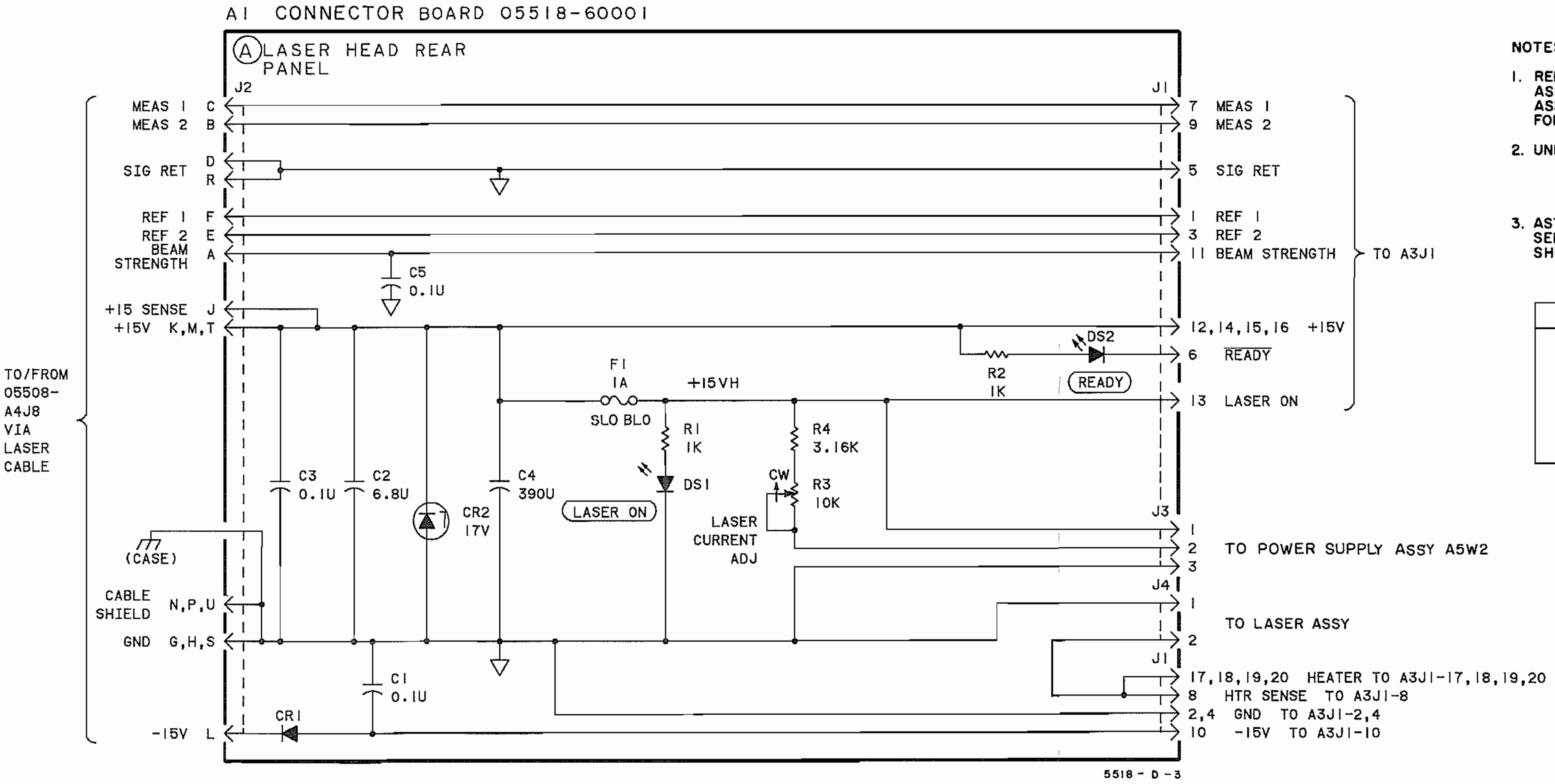
The laser assembly output power should be checked according to Laser Power Output Test, Paragraph 4-16.

The sampler assembly can be checked as follows:

1. Remove power from the 5518A.
2. Remove A4
3. Rest the test polarizer, HP P/N 1000-0616, (supplied with 5518A), against the exposed Reference Receiver exit port of the sampler. The test polarizer will serve as a viewing screen in order to examine the laser beam which is normally incident on the Reference Receiver photodiode. Apply power to the 5518A. Examine the laser beam cross section illuminating the polarizer. It should be circular and centered within a few millimeters with respect to the exit port although slight eclipsing is normal. If any intensity variations are visible across the beam diameter they should be straight regularly spaced lines of high and low intensity, not spots or irregular shapes. Rotate the polarizer 90° and repeat the above observations. The sampler can be removed and the internal beam splitters and polarizers examined for scratches dirt or cloudiness. Check the A3CR5 lens for scratches, dirt, or cloudiness. Also, see Liquid Crystal Troubleshooting, step f.


CONNECTOR BOARD
TEST
S2
NORM
05518-60001
D
F1
J2
J2
(ON OTHER SIDE)
J3
J3
R1
DS1
(ON OTHER SIDE)
DS2
(ON OTHER SIDE)
1
2
R2
S1
R3
J1
CR1
J1
C1
C2
CR2
C3
19
C4
R4
J4
DO NOT REMOVE J4
C5

NOTE: Switches S1 and S2 have been deleted in 5518A A1 Connector boards with Date Codes 90232 and above.


A1 CONNECTOR BOARD 05518-60001
(A) LASER HEAD REAR PANEL
J2
J1
MEAS 1 C
MEAS 2 B
SIG RET D R
REF 1 F
REF 2 E
BEAM STRENGTH A
+15 SENSE J
+15V K,M,T
TO/FROM 05508-A4J8 VIA LASER CABLE
(CASE)
CABLE SHIELD N,P,U
GND G,H,S
-15V L
C5 0.1U
C3 0.1U
C2 6.8U
CR2 17V
C4 390U
F1 1A SLO BLO
+15VH
R1 1K
DS1
LASER ON
R4 3.16K
CW
R3 10K
LASER CURRENT ADJ
R2 1K
DS2
READY
C1 0.1U
CR1
7 MEAS 1
9 MEAS 2
5 SIG RET
1 REF 1
3 REF 2
11 BEAM STRENGTH
TO A3J1
12,14,15,16 +15V
6 READY
13 LASER ON
J3
1
2 TO POWER SUPPLY ASSY A5W2
3
J4
1 TO LASER ASSY
2
J1
17,18,19,20 HEATER TO A3J1-17,18,19,20
8 HTR SENSE TO A3J1-8
2,4 GND TO A3J1-2,4
10 -15V TO A3J1-10
5518-D-3

NOTES:

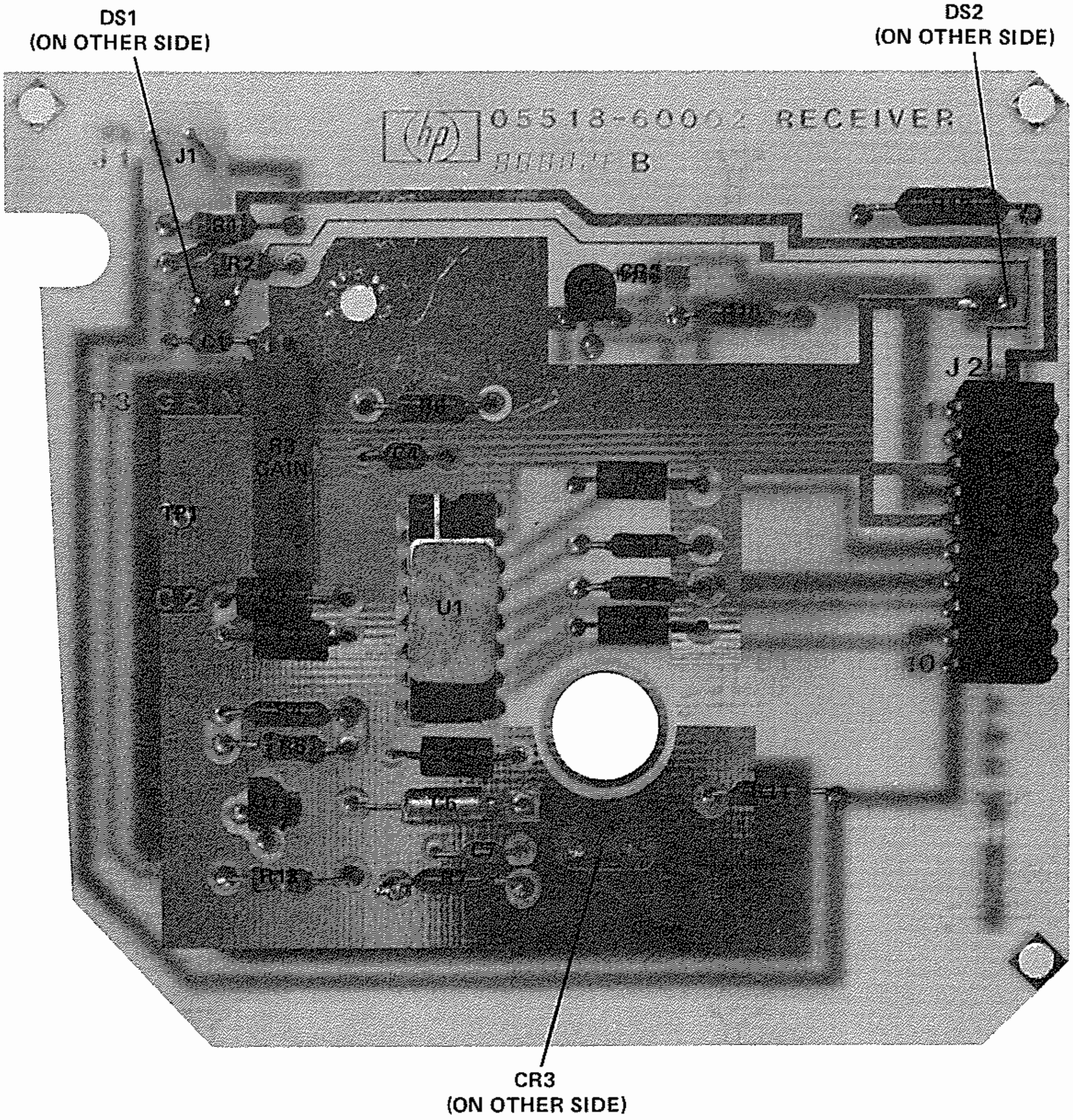
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN FARADS;
   INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.

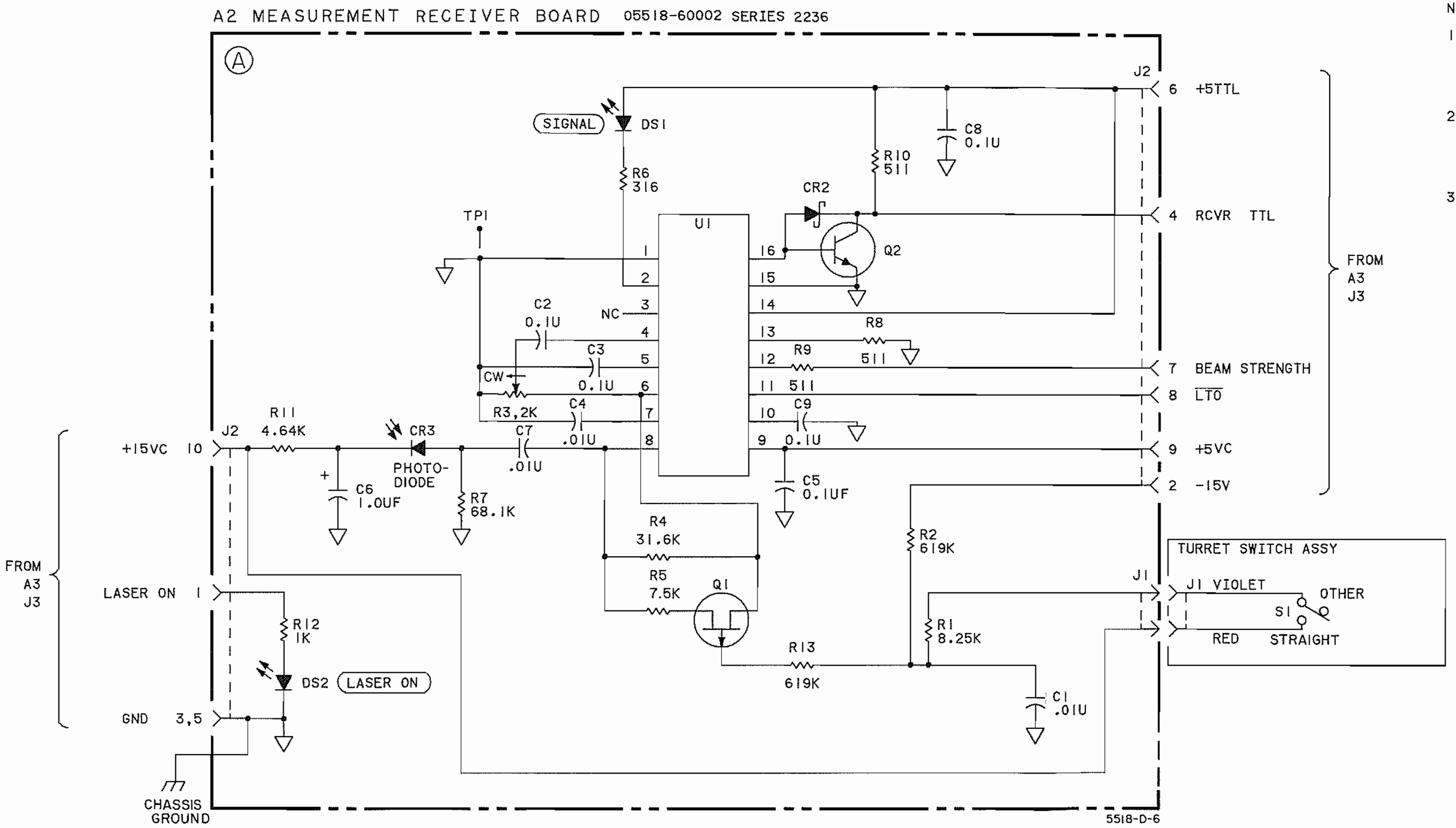
Reference Designations
C1-5
CR1, 2
DS1, 2
F1
J1-4
R1-4

Figure 8-C-12. 5518A A1 Connector Board 05518-60001

Figure 8-C-12
5518A A1 CONNECTOR BOARD 05518-60001

[See Page 8-C-37]


DS1
(ON OTHER SIDE)
DS2
(ON OTHER SIDE)
05518-6000 RECEIVER
B
J1
J2
R3 GAIN
TP1
C2
U1
10
CR3
(ON OTHER SIDE)


A2 MEASUREMENT RECEIVER BOARD 05518-60002 SERIES 2236
A
J2
6 +5TTL
4 RCVR TTL
7 BEAM STRENGTH
8 LTO
9 +5VC
2 -15V
FROM
A3
J3
SIGNAL
DS1
R6
316
R10
511
C8
0.1U
CR2
Q2
TP1
U1
1
2
3
4
5
6
7
8
16
15
14
13
12
11
10
9
NC
C2
0.1U
C3
0.1U
CW
R3,2K
C4
.01U
R8
511
R9
511
C9
0.1U
C5
0.1UF
R11
4.64K
CR3
PHOTO-
DIODE
C7
.01U
+15VC 10
J2
C6
1.0UF
+
R7
68.1K
R4
31.6K
R5
7.5K
Q1
R2
619K
R1
8.25K
R13
619K
C1
.01U
FROM
A3
J3
LASER ON 1
R12
1K
DS2
LASER ON
GND 3,5
CHASSIS
GROUND
TURRET SWITCH ASSY
J1
J1 VIOLET
OTHER
S1
RED
STRAIGHT
5518-D-6

NOTES:

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN FARADS;
   INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.

REFERENCE DESIGNATIONS

A2
C1-9 CR2-3 DS1-2 J1-2 Q1-2 R1-13 TP1 U1 DELETED CR1

DELETED CR1

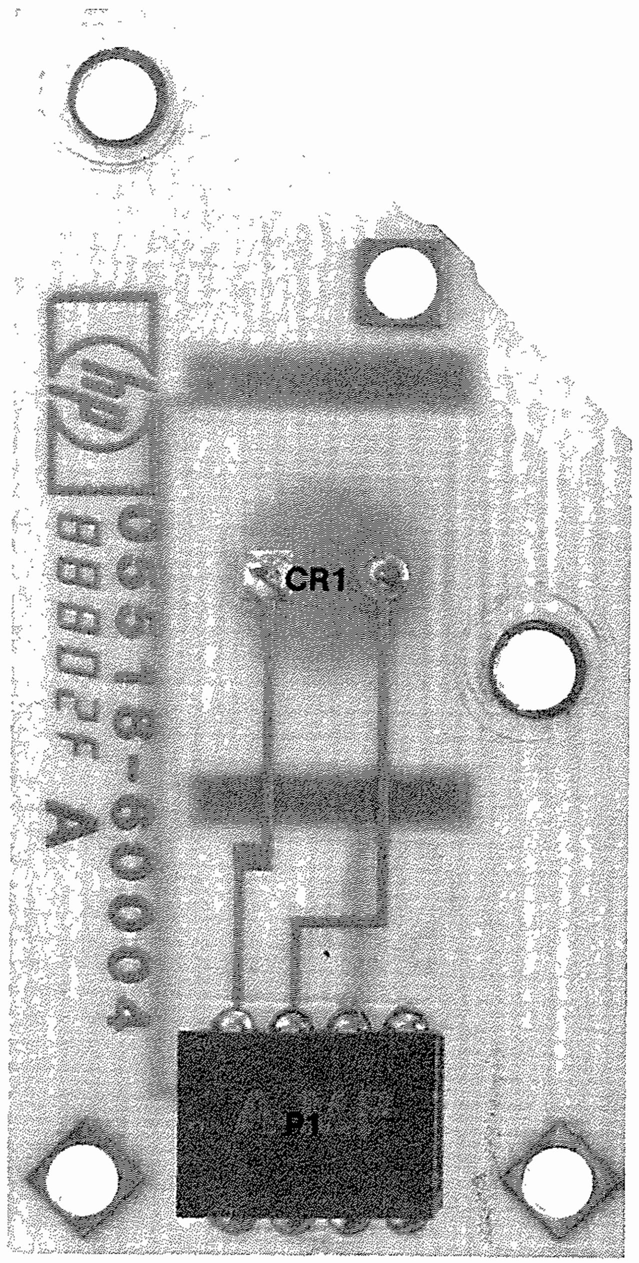
TABLE OF ACTIVE ELEMENTS

REF DES	HP PART NO.	MFR PART NO.
Q1	1855-0082	1855-0082
Q2	1854-0215	2N3904
U1	1826-0775	1826-0075

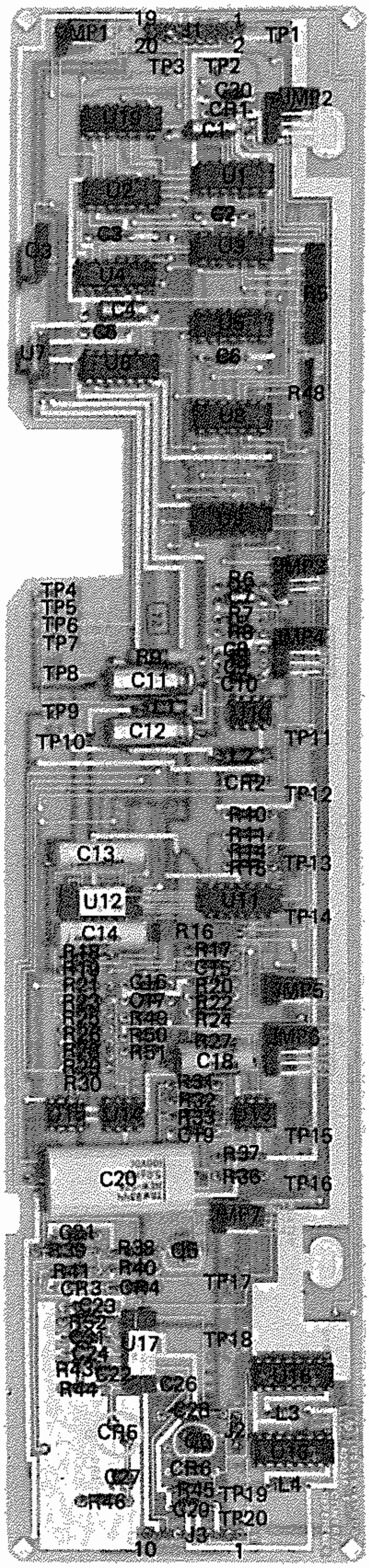
Figure 8-C-13. 5518A A2 Receiver Board 05518-60002

Figure 8-C-13
5518A A2 RECEIVER BOARD 05518-60002

(See Page 8-C-39)


05518-60004
88802F
A
CR1
P1

A4 SAMPLER BOARD
COMPONENT LOCATOR


MP1
19
20
1
2
TP1
TP3
TP2
MP2
U10
C1
U1
U2
C2
C3
U9
U4
U7
U5
U8
R48
MP3
TP4
TP5
TP6
TP7
TP8
R6
R7
R9
C11
C10
TP9
C12
TP10
TP11
CR2
TP12
R40
C13
TP13
U12
U11
TP14
C14
R16
R17
R20
R22
R24
R30
MP5
C18
TP15
C20
R37
R36
TP16
R38
R40
CR3
CR4
TP17
U17
TP18
R43
R44
C22
C26
L3
CR6
CR8
R45
TP19
TP20
R46
J3
10
1

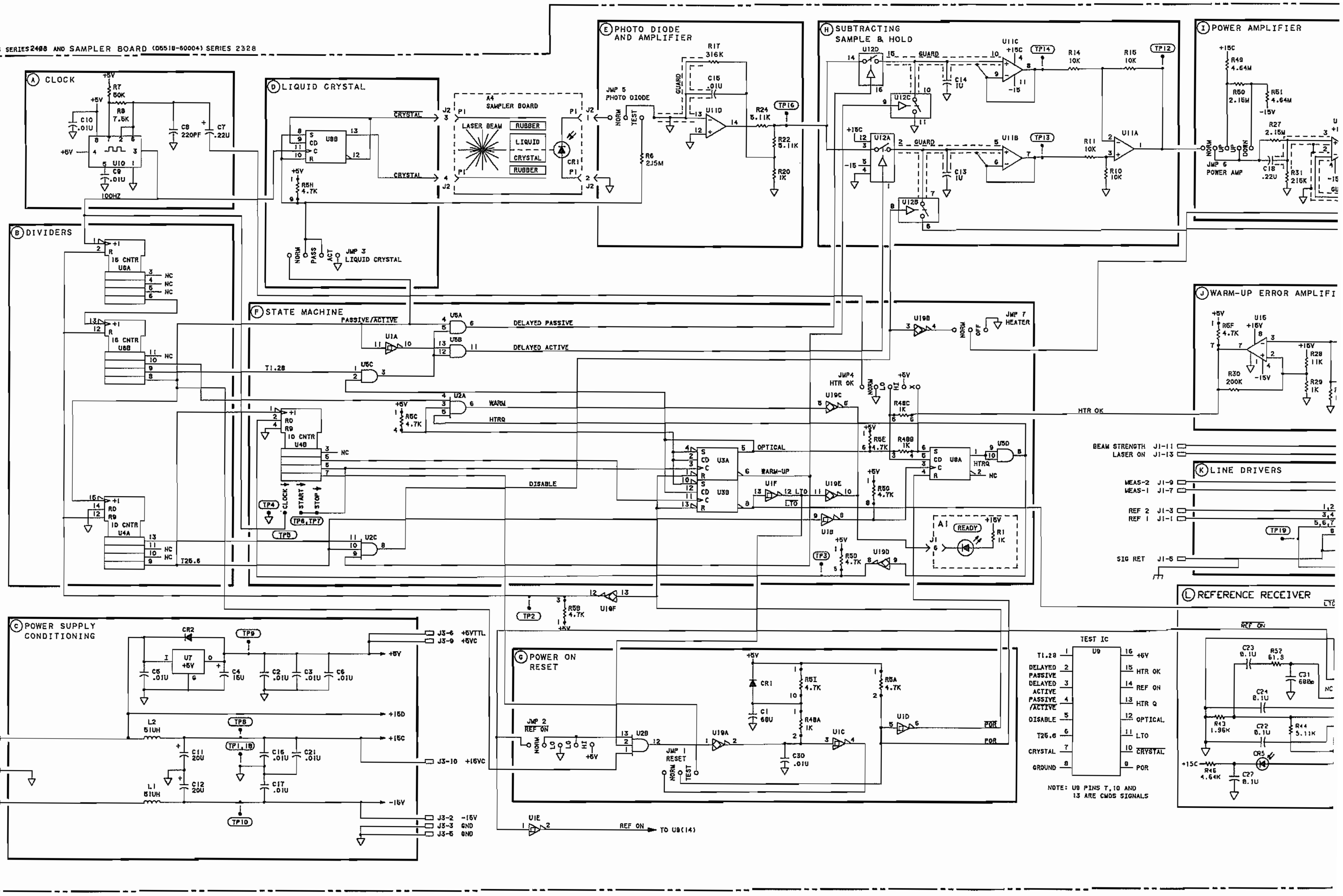
CONTROLLER/REFERENCE COMPONENT LOCATOR (SERIES 2408)

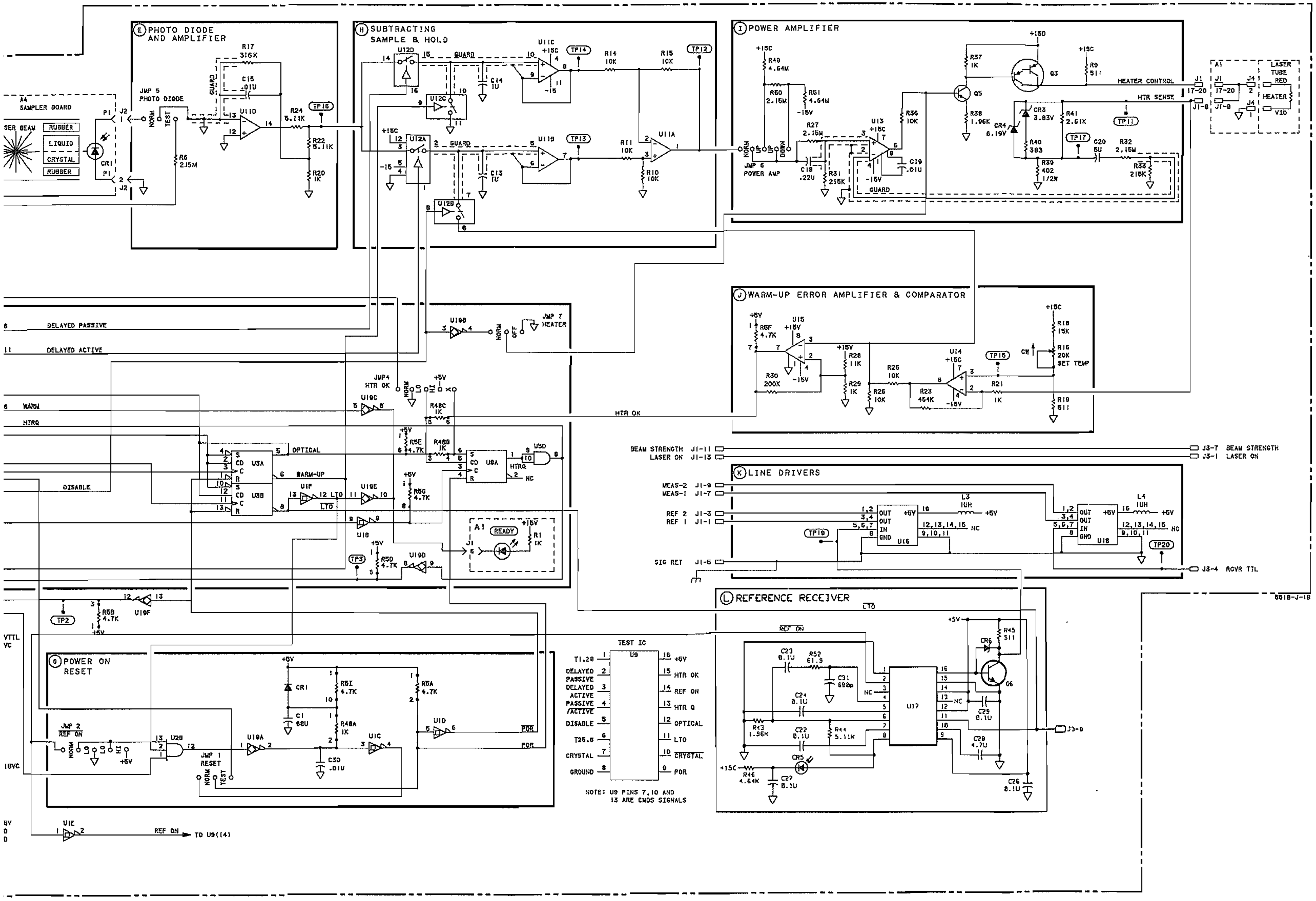
A3 CONTROLLER/REF BOARD (05518-60003 SERIES 2498 AND SAMPLER BOARD (05518-60004) SERIES 2328

A3J1 PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	REF 1	TO A1J1-1	Ⓚ
2	GND	FROM A1J1-2	Ⓒ
3	REF 2	TO A1J1-3	Ⓚ
4	GND	FROM A1J1-4	Ⓒ
5	SIG RET	FROM A1J1-5	Ⓚ
6	READY	TO A1J1-6	Ⓕ
7	MEAS 1	TO A1J1-7	Ⓚ
8	HEATER SENSE	TO A1J1-8	Ⓘ
9	MEAS 2	TO A1J1-9	Ⓚ
10	-15V	FROM A1J1-1	Ⓒ
11	BEAM STRENGTH	TO A1J1-11	Ⓚ
12	+15V	FROM A1J1-12	Ⓒ
13	LASER ON	FROM A1J1-13	Ⓚ
14	+15V	FROM A1J1-14	Ⓒ
15	+15V	FROM A1J1-15	Ⓒ
16	+15V	FROM A1J1-16	Ⓒ
17	HEATER CNTRL	TO A1J1-17	Ⓘ
18	HEATER CNTRL	TO A1J1-18	Ⓘ
19	HEATER CNTRL	TO A1J1-19	Ⓘ
20	HEATER CNTRL	TO A1J1-20	Ⓘ

A3J2 PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	NORM	FROM A4CR1	Ⓕ
2	GROUND	TO A4CR1	Ⓕ
3	CRYSTAL	TO A4CR1	Ⓓ
4	CRYSTAL	TO A4CR1	Ⓓ

A3J3 PIN	SIGNAL	TO/FROM	FUNCTION BLOCK
1	LASER ON	TO A2J2-1	Ⓚ
2	-15V	TO A2J2-2	Ⓒ
3	GND 1	FROM A2J2-3	Ⓒ
4	RCVR TTL	FROM A2J2-4	Ⓚ
5	GND 2	FROM A2J2-5	Ⓒ
6	+5V TTL	TO A2J2-6	Ⓒ
7	BEAM STRENGTH	FROM A2J2-7	Ⓚ
8	LTO	TO A2J2-8	Ⓛ
9	+5VC	TO A2J2-9	Ⓒ
10	+15VC	TO A2J2-10	Ⓒ


Ⓐ CLOCK
R7 50K
R8 7.5K
C10 .01U
U10
C9 .01U
100HZ
C8 220PF
C7 .22U
Ⓓ LIQUID CRYSTAL
U8B
CRYSTAL
R5H 4.7K
NORM PASS ACT
JMP 3 LIQUID CRYSTAL
A4 SAMPLER BOARD
LASER BEAM
RUBBER
LIQUID CRYSTAL
CR1
Ⓔ PHOTO DIODE AND AMPLIFIER
JMP 5 PHOTO DIODE
NORM TEST
R17 316K
C15 .01U
GUARD
U11D
R24 5.11K
TP16
R22 5.11K
R20 1K
R6 215M
Ⓗ SUBTRACTING SAMPLE & HOLD
U12D
U12C
U12A
U12B
U11C
U11B
U11A
C14 1U
C13 1U
TP14
TP13
TP12
R14 10K
R15 10K
R11 10K
R10 10K
Ⓘ POWER AMPLIFIER
R49 4.64M
R50 2.15M
R51 4.64M
R27 2.15M
JMP 6 POWER AMP
C18 .22U
R31 215K
Ⓑ DIVIDERS
16 CNTR U6A
16 CNTR U6B
10 CNTR U4B
10 CNTR U4A
NC
T1.28
T25.6
Ⓕ STATE MACHINE
PASSIVE/ACTIVE
U5A
U1A
U5B
U5C
U2A
U3A
U3B
U8A
U5D
U2C
DELAYED PASSIVE
DELAYED ACTIVE
WARM
HTRQ
OPTICAL
WARM-UP
DISABLE
LTO
U19B
JMP 7 HEATER
JMP4 HTR OK
U19C
U19E
U1F
U1B
U19D
R5C 4.7K
R48C 1K
R5E 4.7K
R48B 1K
R5G 4.7K
R5D 4.7K
HTR OK
A1
READY
R1 1K
TP4
CLOCK
START
STOP
TP5
TP6,TP7
TP3
TP2
R5B 4.7K
U19F
Ⓙ WARM-UP ERROR AMPLIFI
R5F 4.7K
U16
R28 11K
R29 1K
R30 200K
BEAM STRENGTH J1-11
LASER ON J1-13
Ⓚ LINE DRIVERS
MEAS-2 J1-9
MEAS-1 J1-7
REF 2 J1-3
REF 1 J1-1
SIG RET J1-5
TP19
Ⓛ REFERENCE RECEIVER
REF ON
Ⓒ POWER SUPPLY CONDITIONING
CR2
U7 +5V
C5 .01U
C4 15U
C2 .01U
C3 .01U
C6 .01U
TP9
L2 51UH
L1 51UH
TP8
TP1,18
C11 20U
C12 20U
C16 .01U
C21 .01U
C17 .01U
TP10
+15V J1-12,14,15,16
GND J1-2,4
-15V J1-10
J3-6 +5VTTL
J3-9 +5VC
J3-10 +15VC
J3-2 -15V
J3-3 GND
J3-5 GND
+5V
+15D
+15C
-15V
Ⓖ POWER ON RESET
JMP 2 REF ON
NORM LO HI
U2B
U19A
U1C
U1D
R5I 4.7K
R5A 4.7K
R48A 1K
CR1
C1 68U
C30 .01U
JMP 1 RESET
NORM TEST
POR
U1E
REF ON
TO U9(14)
TEST IC
U9
T1.28
DELAYED PASSIVE
DELAYED ACTIVE
PASSIVE /ACTIVE
DISABLE
T25.6
CRYSTAL
GROUND
+5V
HTR OK
REF ON
HTR Q
OPTICAL
LTO
CRYSTAL
POR
NOTE: U9 PINS 7,10 AND 13 ARE CMOS SIGNALS
C23 0.1U
R52 61.3
C31 680p
C24 0.1U
R43 1.96K
C22 0.1U
R44 5.11K
CR5
R46 4.64K
C27 0.1U


E PHOTO DIODE AND AMPLIFIER
H SUBTRACTING SAMPLE & HOLD
I POWER AMPLIFIER
J WARM-UP ERROR AMPLIFIER & COMPARATOR
K LINE DRIVERS
L REFERENCE RECEIVER
G POWER ON RESET
A4 SAMPLER BOARD
LASER BEAM
RUBBER
LIQUID
CRYSTAL
RUBBER
A1 LASER TUBE
HEATER CONTROL
HTR SENSE
HEATER
RED
VIO
DELAYED PASSIVE
DELAYED ACTIVE
WARM
HTRQ
DISABLE
OPTICAL
WARM-UP
HTR OK
BEAM STRENGTH J1-11
LASER ON J1-13
J3-7 BEAM STRENGTH
J3-1 LASER ON
MEAS-2 J1-9
MEAS-1 J1-7
REF 2 J1-3
REF 1 J1-1
SIG RET J1-5
J3-4 RCVR TTL
J3-8
A1 READY
JMP 7 HEATER
JMP 5 PHOTO DIODE
JMP 6 POWER AMP
JMP 2 REF ON
JMP 1 RESET
JMP4 HTR OK
TEST IC
T1.28
DELAYED PASSIVE
DELAYED ACTIVE
PASSIVE /ACTIVE
DISABLE
T25.6
CRYSTAL
GROUND
+5V
HTR OK
REF ON
HTR Q
OPTICAL
LTO
CRYSTAL
POR
NOTE: U9 PINS 7, 10 AND 13 ARE CMOS SIGNALS
REF ON → TO U9(14)
5518-J-18

NOTES:

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN FARADS; INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.

REFERENCE DESIGNATIONS
C1-31
CR1-6
J1-3
JMP1-7
L1-4
Q3, 5, 6
R2, 5-11, 14, 33, 36-41, 43, 44, 46, 48-52
TP1-20
U1-19

DELETED C15, Q1, Q2, Q4, R1, R3, R4, R12, R13, R34, R35, R42, R45, R47.

TABLE OF ACTIVE ELEMENTS

Reference Desig.	HP Part No.	Mfr Part No.
Q3	1853-0347	MJE700
Q5, Q6	1854-0215	2N3904
U1	1820-1416	SN74LS14N
U2	1820-1203	SN74LS11N
U3	1820-1112	SN74LS74AN
U4	1820-2078	SN74LS490N
U5	1820-1201	SN74LS08N
U6	1820-2096	SN74LS393N
U7	1820-0122	7805UC
U8	1820-0939	CD4013B3
U9	1260-0510	1260-0510
U10	1820-2466	ICM7555IPA
U11	1826-0753	MC34004BL
U12	1826-0416	LF13331D
U13	1826-0493	MLM308API
U14	1826-0296	1826-0296
U15	1826-0065	UPC311C
U16,18	1820-2668	SN75114N
U17	1826-0775	1826-0775
U19	1820-0471	SN7406N

Figure 8-C-14. 5518A A3 Controller/Reference Board 05518-60003 and A4 Sampler Board 05518-60004

Figure 8-C-14
**5518A A3 CONTROLLER/REFERENCE BOARD 05518-60003
AND A4 SAMPLER BOARD 05518-60004**

(See Page 8-C-41)

SECTION VIII-D
10751A/B AIR SENSOR

Page

Circuit Theory 8-D-1
  Air Pressure 8-D-1
  Air Temperature 8-D-5
  Air Humidity 8-D-5
  Analog Ground 8-D-5
Troubleshooting 8-D-6
  Cautions, Warnings 8-D-6
  Air Sensor Errors 8-D-7
  Humidity Indicator Troubleshooting 8-D-8
  Air Temperature Troubleshooting 8-D-8
  Air Pressure Troubleshooting 8-D-8
Schematic Diagram 8-D-9

SECTION VIII-D

10751A/B AIR SENSOR

8-D-1. 10751A/B AIR SENSOR CIRCUIT THEORY

8-D-2. Paragraphs 8-D-4 through 8-D-27 contain circuit theory for the 10751A/B. Paragraphs 8-D-28 through 8-D-40 cover the troubleshooting information.

8-D-3. The schematic diagram for 10751A/B is shown in Figure 8-D-4. The schematic has functional blocks that are labeled alphabetically with circled letters. These labels correspond to the circled letters in the text for the circuit theory.

8-D-4. The 10751A/B Air Sensor measures air pressure and air temperature and has provision for entering one of three values of ambient humidity, "high", "low", or "normal". These are supplied in signal form, AP, AT, and AH to the Processor in the 5508A Measurement Display where they are used to compensate for the dependence of laser wavelength on the permittivity of air.

8-D-5. Air Pressure

8-D-6. Pressure Signal Offset Circuitry Ⓐ Ⓓ Ⓖ

8-D-7. The offset adjustment circuits consist of +10 V offset U5-Q2, -10 V offset U4, and offset calibration network R7. The -10 V offset is derived from the +10 V offset by means of U4 which has a gain of -1. Resistors R19A and B are precision resistors and R18 is the bias current compensating resistor. Jumper S1 allows for either positive or negative offset adjustments and is used only during calibration.

8-D-8. The ±10 V at the output of S1 is divided to ±74.4 mV by R12 and R11 and applied to jumpers S10-S17. The jumpers can apply either ±74.4 mv or ground to the R/2R network. The information applied to R7 by the jumpers is treated as a binary integer B (where $0 \leq B \leq 255$). The Jumpers are set during the calibration procedures and there after should not be changed. The output of the R/2R network (pin 16) is:

$$V_{out} = (B \div 256) \times V_{in}$$

Example:

$$V_{out} = (51 \div 256) \times 74.4 \text{ mV}$$

$$V_{out} = 14.8 \text{ mV}$$

8-D-9. U1 amplifies the output of R7 (pin 16) by 2 and sums it with the pressure signal from U3 to form AP. This gives a maximum AP offset of $\pm(74.4 \text{ mV} \times 2) = 148.8$ mV. Full-scale output is 0.95 Volts. The resultant adjustment range is nominally ±16 percent. The air pressure characteristics are shown in Figure 8-D-1.

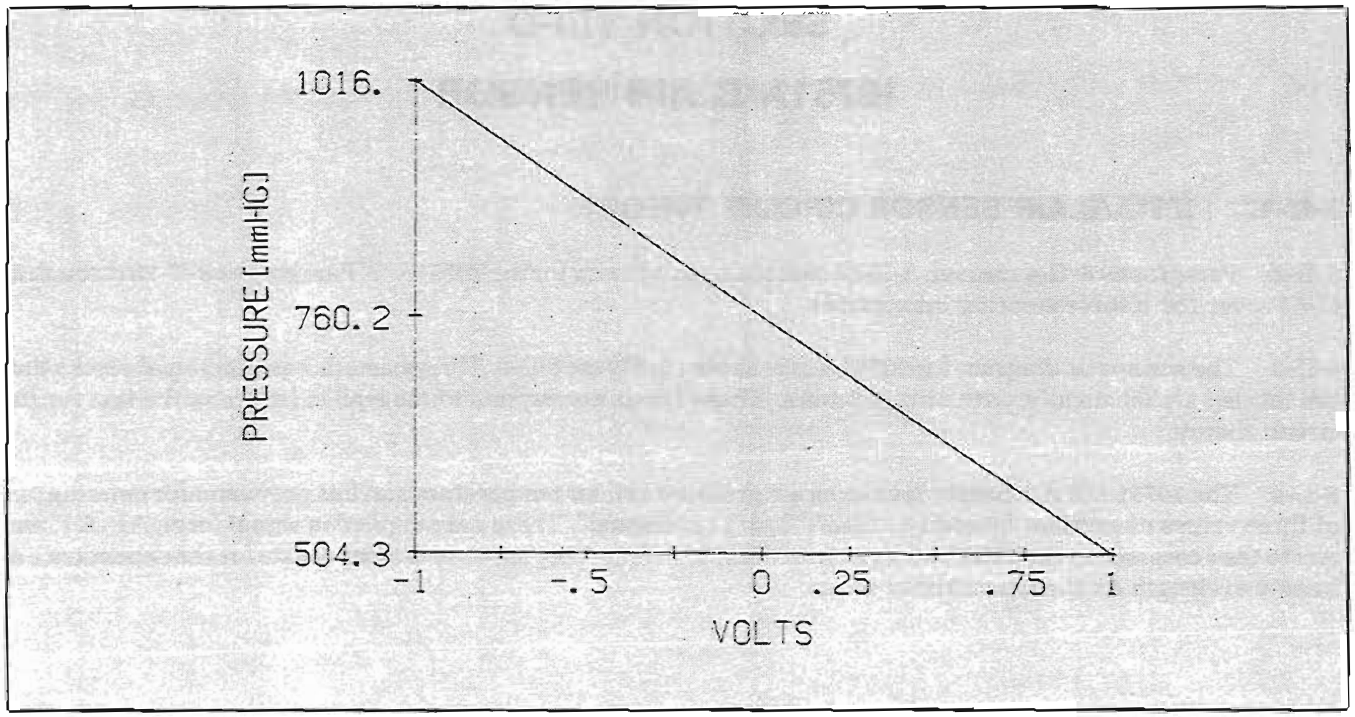


Figure 8-D-1. *Air Pressure Characteristics*

8-D-10. Pressure Signal Gain Circuitry Ⓔ Ⓗ Ⓙ Ⓚ

8-D-11. The block diagram for the Commutating Auto-Zero (CAZ) Instrumentation Amplifier U3 is shown in Figure 8-D-2. U3 provides amplification of the pressure transducer output (30 mV) with an accuracy of 0.1% full scale. The commutation of the differential to single-ended voltage converter allows the instrumentation amplifier to have a frequency response from DC to 10 Hz. Capacitors C10 and C11 are alternately connected to the differential inputs, then to the + input of the CAZ operational amplifier and ground.

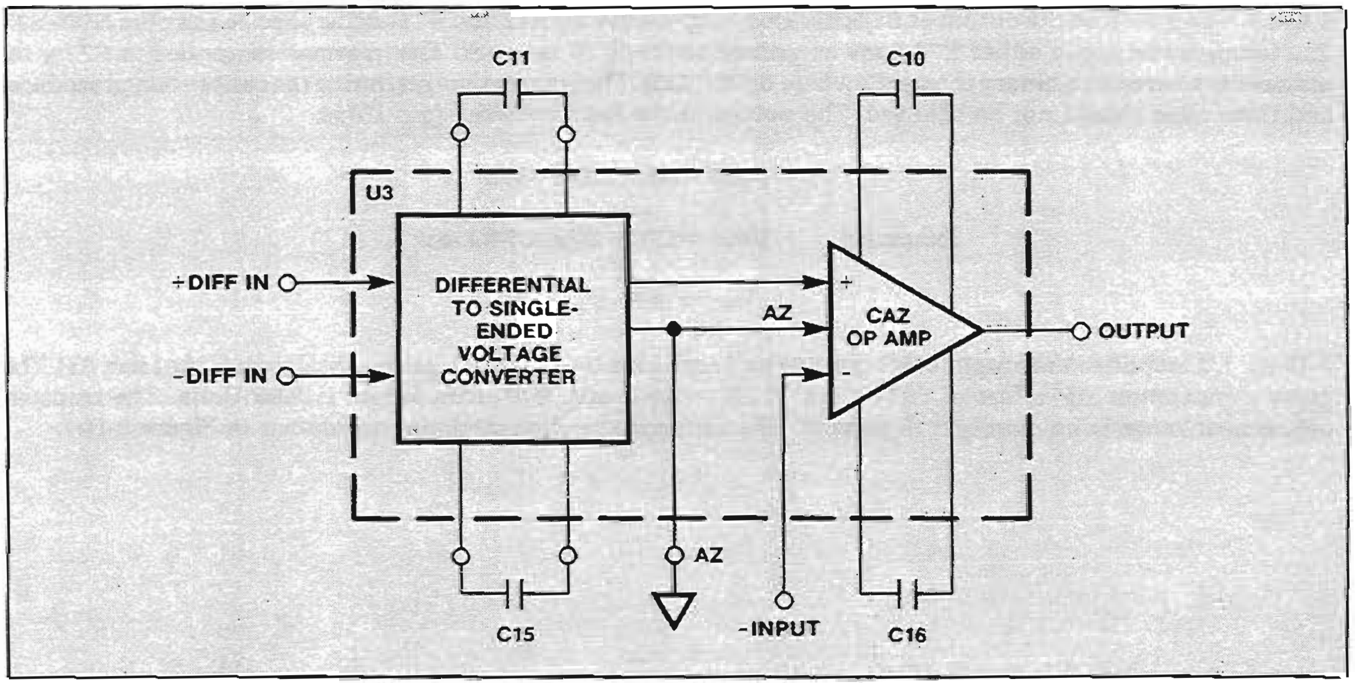

C11
C10
U3
+DIFF IN
-DIFF IN
DIFFERENTIAL TO SINGLE-ENDED VOLTAGE CONVERTER
AZ
+
-
CAZ OP AMP
OUTPUT
AZ
C15
-INPUT
C16

Figure 8-D-2. *Instrumentation Amplifier Block Diagram*

8-D-12. The CAZ op amp section of the amplifier contains two op amps whose functions alternate to provide the auto zeroing feature. Referring to Figure 8-D-3, the CAZ op amp has a third input terminal, AZ. The voltage on the AZ input is the level to which each of the internal op amps is auto-zeroed. In mode A, op amp number 2 is configured in a unity gain mode by integrated switches and charges C16 to a voltage equal to the input offset voltage of the amplifier. While C16 is charging, op amp number 1 passes the input signal with its input compensated by C10. In mode B, the functions of the internal op amps are switched.

NOTE

The voltages of C10, C16, C11, C15 cannot be measured without affecting amplifier output.

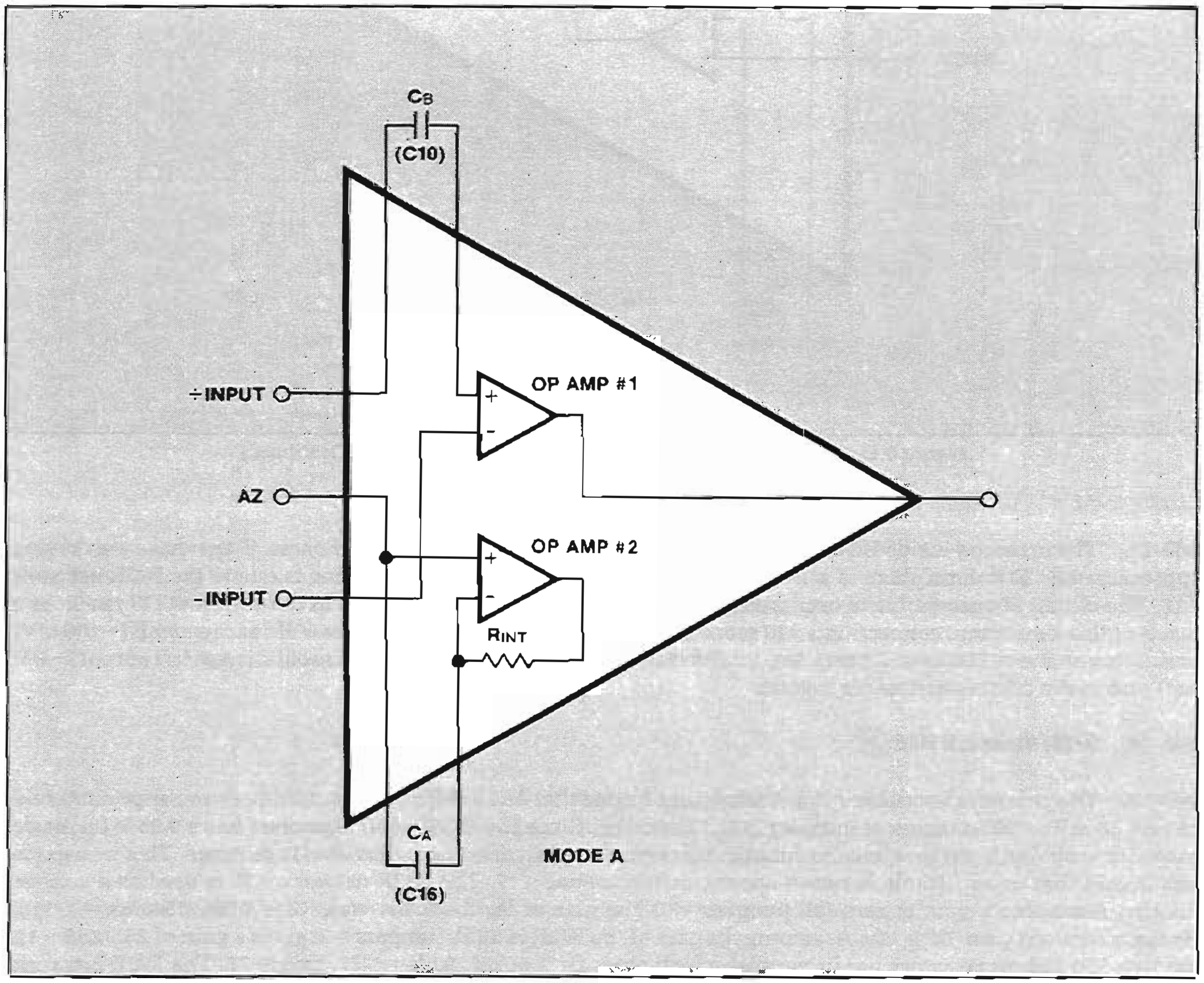


Figure 8-D-3. Operation Cycle of CAZ Operational Amplifier

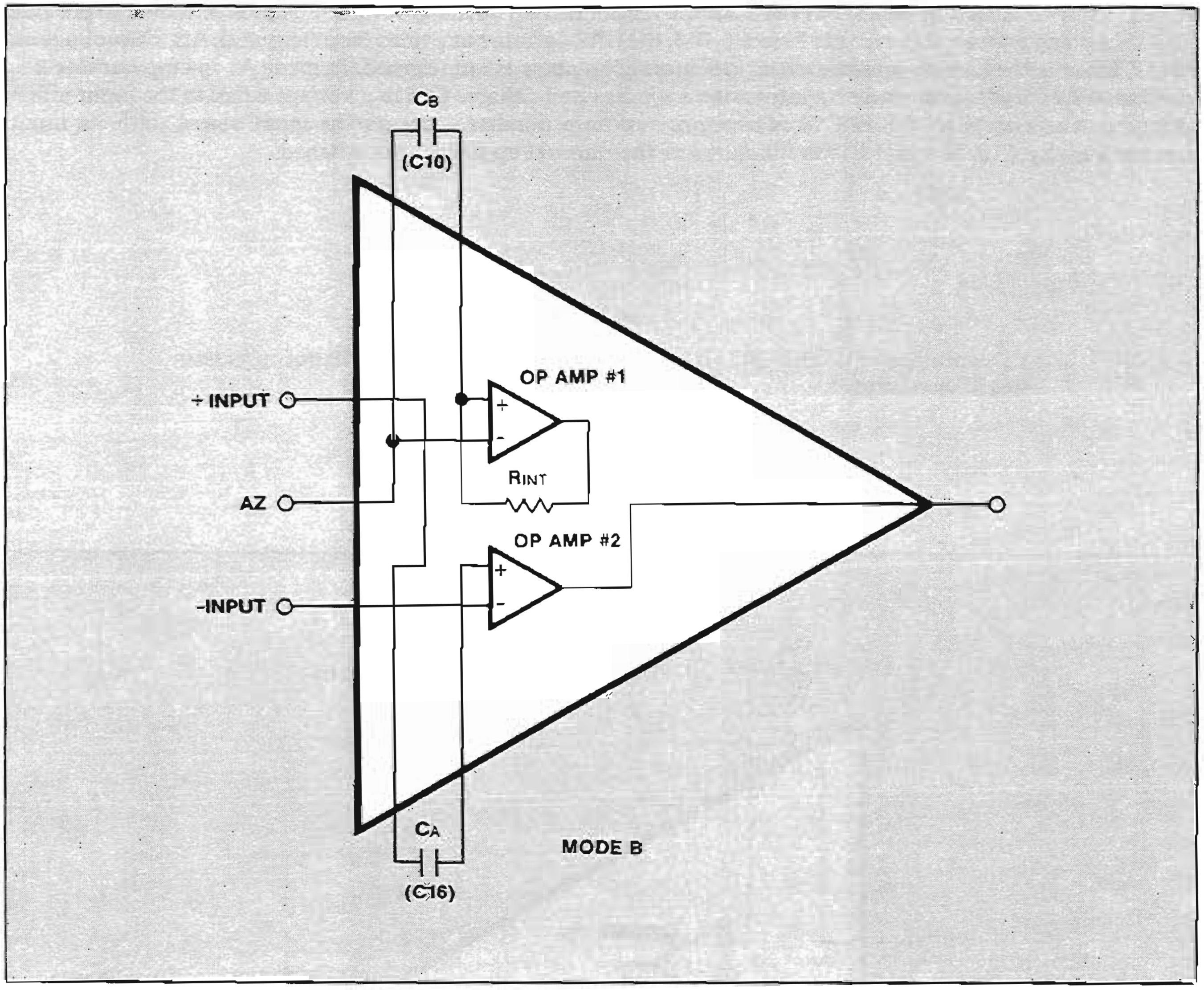


Figure 8-D-3. Operation Cycle of CAZ Operational Amplifier (Continued)

8-D-13. The op amps inside U3 are CMOS and have an output impedance of 50 kohms. Since these are driving approximately 20 kohms, there is some loss of open loop gain. Most of this loading is due to the R/2R network R16. The circuit is susceptible to oscillation when a capacitive load is connected to the output at U3 pin 9. As a result of this limitation, connecting a x10 scope probe to the output of the amplifier will cause a small (~100 mV) oscillation at about 100 kHz. Connecting a voltmeter to this node may result in an oscillation at full output (~8 V p-p) and make all measurements invalid.

8-D-14. R/2R Network R16 Ⓗ

8-D-15. The pressure transducer is a strain-gauge bridge that has a differential output between approximately 25 and 38 mV at 30.54 inches of mercury (775.72 mm Hg). Since the 5508A A/D Converter has a 0.95 V full scale range for unipolar input to minimize quantization error, amplification up to this level is required. This translates into a gain that is adjustable between approximately 89 and 117. The R/2R network R16 is used as a voltage divider. Assuming a gain of zero (all jumpers = 0), the gain of feedback network R9 is 4.66k/554.66k = 1/119, giving a forward gain 1/f = 118. Assuming the gain of the R/2R is 1 (all jumpers = 1, gives a gain of 255/256 ~ 1), the two 550 kohms resistors are in parallel which gives f = 4.66k/359.5k = 1/77, gain = 77. The R/2R network jumpers S2 through S9 are set during calibration and should not be changed otherwise.

8-D-16. Potentiometer R8 allows finer resolution since the R/2R adjustment resolution is limited to 8 bits. With a potentiometer accuracy of 1% (limited by shock and vibration), the combination of digital and potentiometer adjustment provides adjustment accuracy of 0.006%.

8-D-17. Output Buffer U1 Ⓙ

8-D-18. U1 performs three functions. First, it buffers the high impedance output of U3 providing a low impedance source capable of driving the Air Sensor cable and the input impedance of the 5508A analog inputs. Second, a low pass filter configuration is used to remove the commutation spikes from U3's output. Third, the offset adjustment developed by R7 is summed into AP.

8-D-19. The low pass filter configuration is a 2nd order filter with poles at 0.3 and 2.1 Hz, a precise DC gain of 1 for the signal from U6, and a gain of 2 for the offset signal from R7. Precision resistor network R15 determines the gain. R6 affects AC gain only. R5 is a bias current compensation resistor.

8-D-20. Air Temperature Ⓘ

8-D-21. The air temperature measurement is identical to the temperature measurement of the material temperature sensors with the exception that the Air Sensor temperature transducer AT is mounted on a heatsink in free air.

8-D-22. The air transducer is an absolute temperature sensor which outputs 1 microampere per degree kelvin. Operational amplifier U2 provides current to voltage conversion with a trans-resistance gain of 33.5 k ohm (33.5 kohm = R1 + R3). The input range of the A/D converter in the 5508A Measurement Display is $-1\ \text{V} \le \text{Vin} \le +1\ \text{V}$. +10 Vref is applied to the positive input of U2 to provide the necessary offset. At 25.36 degrees centrigrade, the op amp output, AT, equals 0 Volts. It has a slope of -33.5 mV/°C over the entire operating temperature range. Resistor R2 is a bias current compensation resistor. C2 eliminates noise from the temperature signal (MT) which is essentialy DC, and A2C1 and A2C2 provide EMI rejection.

8-D-23. Air Humidity Ⓕ

8-D-24. Humidity has very little effect on the speed of light in air. For example, it exerts only 0.1ppm error on a distance measurement for 10% humidity error. For this reason, only three humidity selections are provided, 25%, 50% and 75%. These ranges are selected by a switch on the Air Sensor. If the switch is optimally set*, the maximum humidity error is 15% yielding 0.15 ppm measurement error. The signal AH is either ground, ~0.7 V or ~-0.7 V. The 5508A uses thresholds at ±0.5 V for this measurement, if AH is above +0.5V, RH = 75% below -0.5 V, RH = 25%, and between -0.5 V and +0.5 V, RH = 50%.

$$\text{low} = \frac{50 + 25}{2} = 37.5\%$$

$$\text{high} = \frac{75 \div 25}{2} = 62.5\%$$

8-D-25. Analog Ground

8-D-26. The 10751A/B Air Sensor is an analog circuit, whose outputs are measured by the 5508A A/D Converter with respect to true ground (5508A chassis). Ignoring U6, it is not feasible to have a low-current ground line to which AT and AP could be referenced. All of the connections tied to the ⏚ symbol on the schematic must be referred to true ground. Unfortunately, this would feed to much current back on the ground lead causing between 1.5 mV to 7 mV of ground drop depending on the resistance of the grounds wire.

Optimal switch setting (Operator selected) for low and high

8-D-27. U6, Q1 and R17 are used to provide an alternate path for the air sensor ground current. U6 measures and replicates analog ground with a maximum offset of 150 uV and diverts the ground current from all Air Sensor ⏚ symbols into the ±15 V supplies. Analog ground is the same as the 5508A chassis potential and connects to the + input of U6. The replicated ground exists at the output of U6. CR3 protects the circuitry should the ground buffer fail, and resistor R3 protects Q1 against the loss of the analog ground signal. R17 lessens the current load on Q1 to reduce its power dissipation.

8-D-28. 10751A/B AIR SENSOR TROUBLESHOOTING

CAUTION

DO NOT CONNECT TEST INSTRUMENT GROUND LEADS TO ANALOG GROUND IF THEY ARE TRUE GROUNDED (THIRD PRONG); OR REFERRED TO GROUND ANYWHERE IN THE 5508.

If you wish to accurately measure a voltage that is referred to ⏚ it can be measured differentially, referred to ⏚ using a voltmeter with floating inputs (e.g., HP 3456A). Note that the inputs to the 5005A Signature Multimeter (recommended service equipment) are NOT floating; the (N) lead is connected to true ground.

Alternatively, you can ground the test instrument probes to the shield ground but remember that some small DC offset will exist between the probe ground and the ground inside the air sensor.

CAUTION

CMOS CHIP's, such as U3, are susceptible to static when removed from a circuit board. U3 is also subject to SCR latchup when either the air sensor is plugged into the 5508A after power-up, or when the ±5 V supplies are shorted. If you suspect that any of the power supplies has momentarily shorted, feel U3. If hot to the touch, turn off power, allow sufficient time to cool, then reapply power. If U3 heats up again within a minute or so, either U3 is bad, or a circuit fault exists which is causing SCR latchup.

Be sure to turn off the 5508A when opening the 10751 housing. The inside of the housing is conductive and catastrophic short circuits may occur.

CAUTION

The pressure transducer, 10751-60303, in the air probe senses pressure on its front face. This face is a stainless steel diaphragm which can be easily deformed by touching or undue pressure. If it is necessary to touch the transducer, avoid touching the diaphragm.

CAUTION

Static electricity can result in permanent degradation or catastrophic failure of the instrument or assemblies removed from the instrument.

All work performed on assemblies or instruments with covers removed must be at a static safe work station that provides proper grounding for the operator.

Always store and transport assemblies in a static shielding bag.

8-D-29. Proper operation of the 10751A/B can be verified when the unit is connected to a 5508A Measurement Display. All measurements can be displayed using the VOL key. The information in Paragraph 8-A-48, 10751A/B and 10757A/B/C Sensor Errors and Paragraph 8-A-79, 10751A/B Isolation should be used to verify that a problem exists in the 10751A/B before consulting the troubleshooting information in this section. Should troubleshooting be required, the 10751A/B Air Sensor Theory of Operation, Paragraph 8-D-1, provides the necessary background for applying the 10751A/B Air Sensor Troubleshooting and Repair Procedures.

8-D-30. If a 10751A/B fails, it is recommended that the unit be returned to Hewlett-Packard. Most repairs require recalibration. The Calibration procedures for the 10751A/B are given in Section IV, Performance Test and Calibration. Field repair is limited to replacing boards A1, A2, the Pressure Transducer, cables, and mechanical parts.

8-D-31. Air Sensor Errors

8-D-32. Temperature Measurements. The 10751A/B produces a voltage level, AT, that decreases linearly with increasing temperature. This signal is bipolar and centered about 0 volts at approximately 25° C (77° F). An error message is displayed by the 5508A if a temperature signal exceeds the ±1 V range of the Analog-to-Digital converter. The temperature measurements require +15 V and - 15 V supplies and +10 Vref from the 5508A. Note that the temperature sensor is calibrated for 0 to 40° C operation which does not require the full ±1 Volt range of the 5508A Analog-to-Digital Converter.

8-D-33. Pressure Measurement. The 10751A/B also measures air pressure by suppling a D.C. voltage, AP, that decreases linearly with increasing air pressure. An error message is displayed by the 5508A if the air pressure signals exceed ±1 Volt. The air pressure signal is bipolar and centered about 0 Volts at 760.2 mm Hg (29.93 inches Hg). +10 Vref is not used for the air pressure measurement, only the +15 V and -15 V power supplies are required.

8-D-34. Humidity Switch. The humidity switch sends one of three voltages to the 5508A:

Switch Setting	**Voltage (Nominal)**
75%	0.7 V (approx)
50%	0.0 V
25%	-0.7 V (approx)

8-D-35. A/D conversion errors or faulty probes can cause probe errors to be displayed by the 5508A (See Paragraph 8-A-44, Error Messages). Inaccurate readings, which do not cause error messages, can also occur. Probe data, in english or metric units, can be observed directly by using procedures described by the front panel key descriptions in Section III.

8-D-36. The 5508A and the probes can be checked without having the Laser Head attached. By setting the Processor Board S/A test switch to 00010000 and toggling MASTER RESET, the 5508A substitutes the system clock frequency into the REF and MEAS counters. In this mode, the 5508A functions exactly as it does in measurement modes except displacement will always read zero (REF = MEAS = 1 MHz). Voltage characteristics for the Air Pressure and Air Temperature signals, as given in Paragraph 8-A-91, can be used for operational verification and trouble isolation.

8-D-37. Humidity Indicator Troubleshooting

8-D-38. The humidity circuit consists of two resistors and a switch. Refer to Analog Ground troubleshooting, Paragraph 8-D-25, before replacing A1.

Switch Position	AH Value (Nominal)
HI	0.7 V
NORM	0.0 V
LOW	-0.7 V

8-D-39. Air Temperature Troubleshooting

a. Verify that +15 V, -15 V and +10 Vref are within tolerances given in Paragraph 8-A-91.

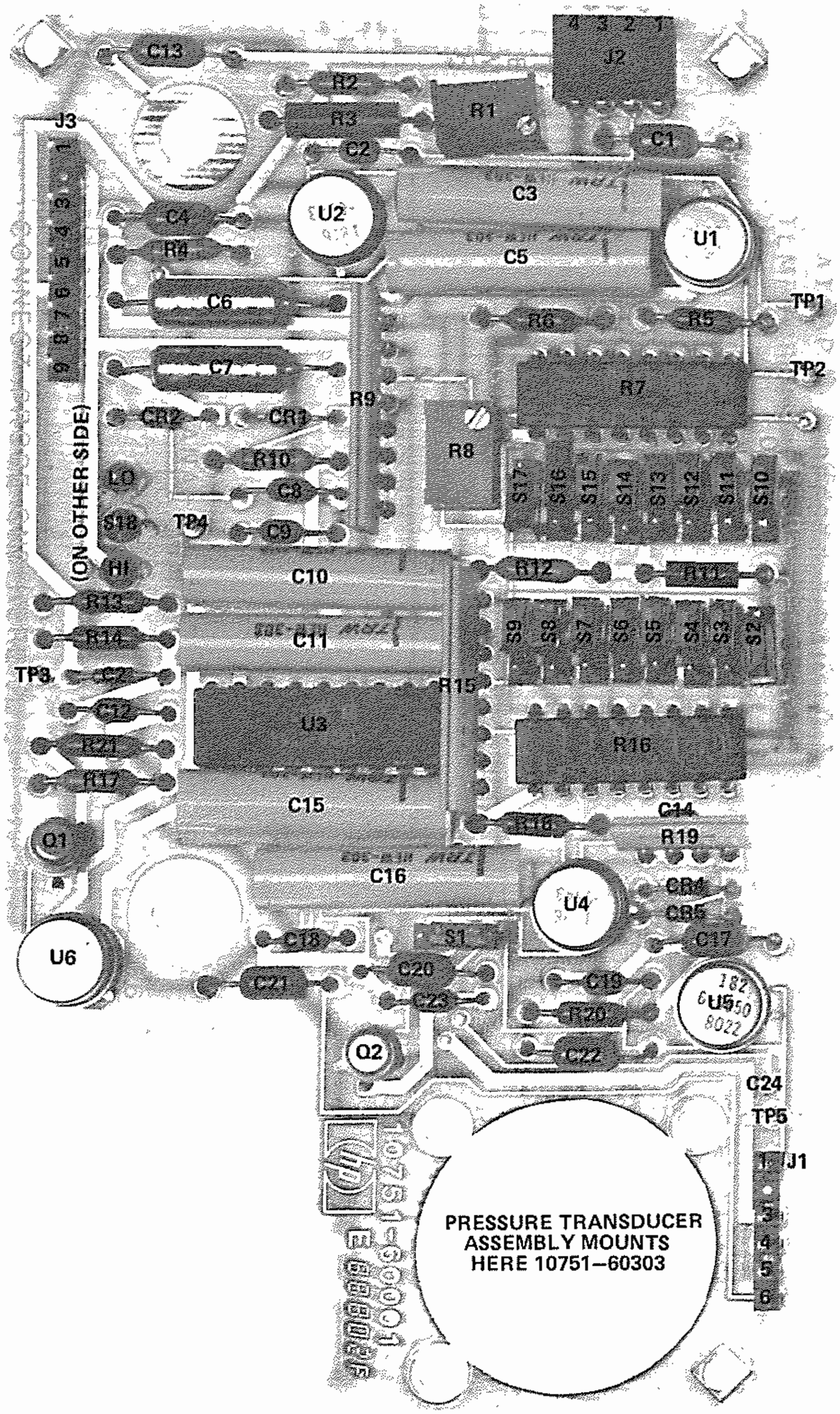
b. Verify +10 Vref on both sides of R3. Voltage drops of more than 1 mV across R3 may indicate a failure of U2. Replace A1.

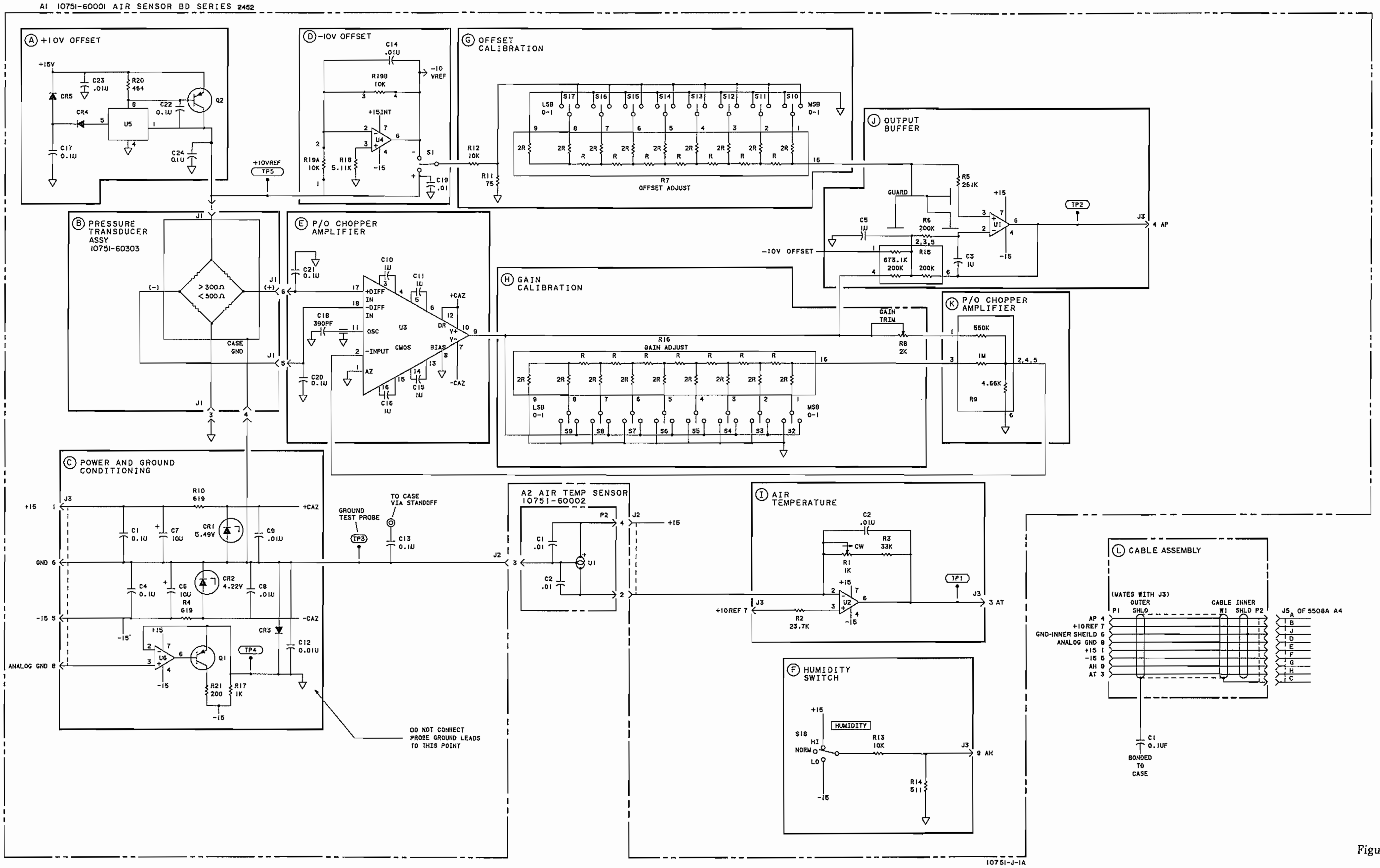
c. Measure voltage on pin 2 of U2. If it is within 1 mV of +10 Vref, verify feedback resistor values before replacing A2. If pin 2 is outside this 1 mV range, disconnect the temperature sensor board from the main board. If pin 2 is now within 1 mV of +10 Vref, replace A2. Otherwise replace A1. U2 output should rise to 10 V with the temperature sensor disconnected.

8-D-40. Air Pressure Troubleshooting

a. Verify that +15 and -15 V are within tolerances given in Paragraph 8-A-91.

b. Check Pressure Transducer output. See Figure 8-D-1. If improper, replace Pressure Transducer. If OK, replace A2.


C13
4 3 2 1
J2
R2
R3
R1
J3
1
3
4
5
6
7
8
9
C2
C1
C3
U2
C4
U1
R4
C5
C6
TP1
R6
R5
C7
TP2
R7
R9
CR2
CR1
R8
R10
S17
S16
S15
S14
S13
S12
S11
S10
LO
C8
S18
TP4
C9
(ON OTHER SIDE)
HI
C10
R12
R11
R13
C11
S9
S8
S7
S6
S5
S4
S3
S2
R14
TP3
C2
R15
C12
U3
R16
R21
R17
C15
C14
Q1
R18
R19
C16
CR4
U4
CR5
S1
C18
C17
U6
C20
C21
C19
C23
U5
R20
C22
Q2
C24
TP5
1
J1
3
4
5
6
10751-60001
PRESSURE TRANSDUCER
ASSEMBLY MOUNTS
HERE 10751–60303


A1 10751-60001 AIR SENSOR BD SERIES 2452
Ⓐ +10V OFFSET
+15V
CR5
C23 .01U
R20 464
Q2
CR4
U5
C22 0.1U
C17 0.1U
C24 0.1U
Ⓓ -10V OFFSET
C14 .01U
-10 VREF
R19B 10K
+15INT
U4
R19A 10K
R18 5.11K
S1
C19 .01
+10VREF
TP5
Ⓖ OFFSET CALIBRATION
S17 S16 S15 S14 S13 S12 S11 S10
LSB 0-1
MSB 0-1
R12 10K
R11 75
R7 OFFSET ADJUST
Ⓑ PRESSURE TRANSDUCER ASSY 10751-60303
J1
>300Ω <500Ω
CASE GND
Ⓔ P/O CHOPPER AMPLIFIER
C21 0.1U
C10 1U
C11 1U
+CAZ
+DIFF IN
-DIFF IN
C18 390PF
OSC
U3
CMOS
-INPUT
AZ
BIAS
C20 0.1U
C16 1U
C15 1U
-CAZ
Ⓙ OUTPUT BUFFER
R5 261K
GUARD
+15
C5 1U
R6 200K
U1
TP2
J3
4 AP
-10V OFFSET
673.1K 200K
R15 200K
C3 1U
-15
Ⓗ GAIN CALIBRATION
GAIN TRIM
R8 2K
R16 GAIN ADJUST
S9 S8 S7 S6 S5 S4 S3 S2
LSB 0-1
MSB 0-1
Ⓚ P/O CHOPPER AMPLIFIER
550K
1M
4.66K
R9
Ⓒ POWER AND GROUND CONDITIONING
+15
J3
R10 619
+CAZ
C1 0.1U
C7 10U
CR1 5.49V
C9 .01U
GND 6
C4 0.1U
C6 10U
CR2 4.22V
C8 .01U
R4 619
-15 5
-CAZ
-15
+15
CR3
C12 0.01U
U6
Q1
TP4
ANALOG GND 8
R21 200
R17 1K
-15
GROUND TEST PROBE
TP3
TO CASE VIA STANDOFF
C13 0.1U
DO NOT CONNECT PROBE GROUND LEADS TO THIS POINT
A2 AIR TEMP SENSOR 10751-60002
P2
J2
C1 .01
C2 .01
U1
+15
Ⓘ AIR TEMPERATURE
C2 .01U
R3 33K
CW
R1 1K
+15
TP1
U2
+10REF 7
J3
R2 23.7K
3 AT
-15
Ⓕ HUMIDITY SWITCH
+15
HUMIDITY
S18
HI
NORM
LO
R13 10K
J3
9 AH
R14 511
-15
Ⓛ CABLE ASSEMBLY
(MATES WITH J3)
P1
OUTER SHLD
CABLE W1
INNER SHLD P2
J5 OF 5508A A4
AP 4
+10REF 7
GND-INNER SHEILD 6
ANALOG GND 8
+15 1
-15 5
AH 9
AT 3
A B J D E F G H C
C1 0.1UF
BONDED TO CASE
10751-J-1A

NOTES:

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN FARADS;
   INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES FACTORY SELECTED COMPONENT, AVERAGE VALUE SHOWN.

A1 TABLE OF ACTIVE ELEMENTS

REF DESIG	HP PART NO.	MFG PART NO.
Q1,2	1853-0281	2N2907A
U1,2,4,6	1826-0543	OP-07CJ
U3	1826-0761	7605
U5	1826-0965	584 KH

REFERENCE DESIGNATIONS

A1
C1-23 CR1-5 J1-3 Q1,2 R1-21 S1-18 TP1-5 U1-6
A2
C1-2 P2 U1

PIN	COLOR	FUNCTION
1	BRN	+15 INT
2	—	KEY
3	ORN	AT
4	YEL	AP
5	BLU	−5V
6	BLK	GND INNER SHIELD
7	WHT/ORN	$+10V_{REF}$
8	WHT/YEL	ANALOG GND
9	WHT/BRN	AH

Figure 8-D-4. 10751A/B Air Sensor

Figure 8-D-4
10751A/B AIR SENSOR

(See Page 8-D-9)

SECTION VIII-E
10757A/B/C MATERIAL TEMPERATURE SENSOR

Page

Circuit Theory 8-E-1

Troubleshooting 8-E-3

Schematic Diagram 8-E-5

SECTION VIII-E
10757A/B/C MATERIAL TEMPERATURE SENSOR

8-E-1. 10757A/B/C MATERIAL SENSOR CIRCUIT THEORY

8-E-2. The 10757A/B/C Material Temperature Sensor furnishes an analog voltage output which varies with changes in sensor temperature (see Figure 8-E-1). The instrument is comprised of three separate functional sections:

a. a temperature-sensing thermistor network

b. an offset adjustment section

c. an analog ground buffer

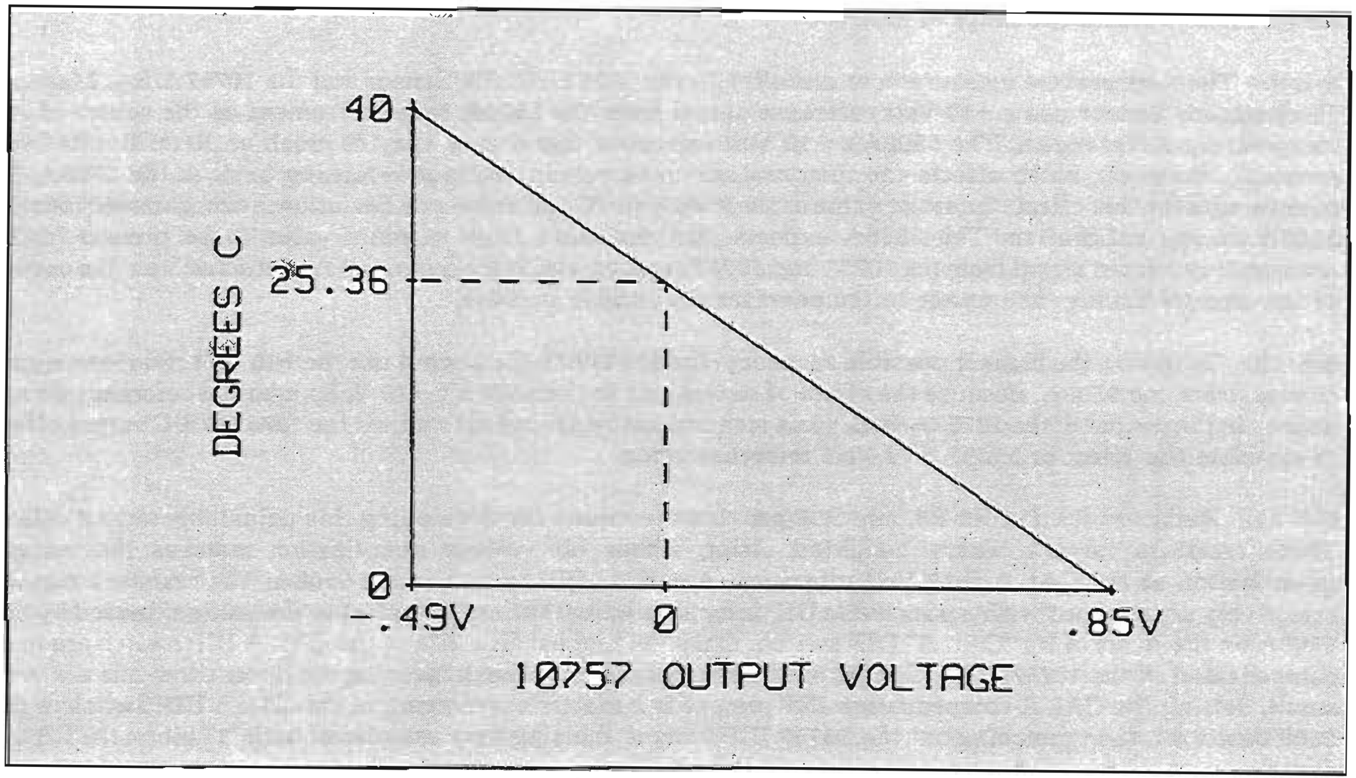


Figure 8-E-1. *Material Temperature Sensor Characteristics*

8-E-3. Thermistor Network

8-E-4. The instrument's main temperature sensing element is made up of two very stable thermistors (T1 and T2) and four precision resistors (R15, R17-R19). Their combined response is computer optimized to give a negative-slope linear resistance-to-temperature characteristic across U3. Resistors R18 and R19 alter the effective resistance of thermistor T1 by a factor of 1+ (R18/R19), or approximately five times. The combination of T2, R15, and R17 bend T1's inverse-logarithmic temperature-resistance response curve to the desired linear response over a 0°C to 40°C range.

8-E-5. Both T1 and T2 have a nominal resistance of 2252 Ohms at 25°C. The combined thermistor-resistor network has a nominal resistance of 2336.5 Ohms at 0°C and a slope of -16.0895 Ohms per degree, with a maximum nonlinearity of about 0.050°C as seen by op amp U3.

8-E-6. The changing resistance of the thermistor-resistor network is converted to a varying voltage by U3, scaled by the constant current passing through resistors R9, R11, and R16. The output terminal of U3 is nominally at:

$$-486.5 \text{ millivolt} + (3.35 \text{ millivolt} \times T)$$

where T is the sensor temperature in degrees C. Output buffer op amp U4 multiplies this potential by a factor of -10, giving an instrument output voltage/temperature slope of -33.5 millivolt/degree C. Gain adjust trimpot R16 allows this slope to be adjusted by ±1% to compensate for thermistor variations and resistor tolerances.

8-E-7. Offset Network

8-E-8. Ideally, the output of the 10757A/B/C is zero Volts at 25.36°C. The output of U3 is equal to -402.2 millivolts at 25.36°C, which is equivalent to a potential of 4.022 Volts at the output of the instrument. This offset is cancelled out by summing in the appropriate fixed potential from voltage reference U1. Resistors R3, R4, R6-R8, R10, R12, and R13 determine the offset magnitude, while trimpot R1 and fixed resistor R2 provide for an offset adjustment range of ±0.9%.

8-E-9. The temperature measurement circuitry in the 10751A/B Air Sensor and the 10757A/B/C Material Temperature Sensor use a +10 Volt reference signal from the 5508A base instrument as the source of the temperature offset signal. The 5508A's +10 Volt reference signal may vary as much as 10 millivolts from nominal, however, which affects the temperature measurement voltage returning back to the 5508A. To compensate for this effect, the exact value of the 5508A's +10 Volt reference deviation is programmed into the 5508A during calibration. The 5508A expects this deviation from nominal value to be present in the temperature output signal from the 10751 and 10757 sensors, and is automatically subtracted from the output of the sensors during the voltage to temperature conversion process.

8-E-10. To obtain the highest possible accuracy, the 10757A/B/C does not use the +10 Volt reference signal coming from the 5508A. Because the effect of deviations in the 5508A's +10 Volts nominal reference do not appear in the output of the 10757A/B/C, some means must be provided to adjust the 10757A/B/C output offset to simulate the effect of 5508A +10 Volt reference error.

8-E-11. Resistors R3, R4, R6-R8, and R10 provide the means for developing this adjustable output offset. These resistors form a binary weighted string whose bit voltage quantization matches the voltage quantization of the CAL A (+10 Volt reference deviation) DIP switch in the 5508A. The resistors may be selectively shorted out with a punchable DIP jumper to adjust the output offset to the value expected by the 5508A on the basis of its "CAL A" DIP switch. Only the highest five bits of the CAL A DIP switch are thus compensated in the 10757A/B/C design, as the errors associated with ignoring the lower three bits are very small. Setting the CAL A compensation DIP jumper is a matter of referring to the CAL A DIP switch in the 5508 base unit, then punching out the 10757 DIP jumper shorting bars associated with "1" bit on the CAL A switch.

8-E-12. Analog Ground Buffer

8-E-13. The temperature measurement signal produced by the 10757A/B/C is returned to the 5508A base unit by a short cable. The measurement signal is referred to the base units internal analog ground potential, which is supplied to the 10757 through the same cable. Drawing power supply current through this ground line would produce a small IR drop in the measurement loop, creating a temperature error proportional to the current flow.

8-E-14. Analog ground buffer U2 creates a high-precision replica of the base unit's analog ground potential while drawing negligible current through the line. Circuitry in the 10757A/B/C is referred to this ground replica rather than actual ground. Ground currents, which would otherwise adversely affect system accuracy, are instead diverted to the ±15 Volt supplies.

8-E-15. 10757A/B/C MATERIAL TEMPERATURE SENSOR TROUBLESHOOTING

NOTE

The 10757A/B/C is not field repairable and can be serviced only by complete replacement through factory exchange. Hewlett-Packard does not provide replacement parts for this product. Contact the nearest HP Sales/Service Office for assistance in exchanging defective instruments for replacement units.

NOTE

The instrument must be recalibrated after any service except after 10757-60304 cable assembly replacement.

8-E-16. If the instrument drifts or is out of specification less than 1°C:

a. Remove 10757-60301/2/3 cable assembly from the A1 Board.

b. Connect board to a 5508A and turn power on. Turn on DVM and connect DVM + and - leads to TP2 and TP1, respectively. After allowing 1/2 hour for instrument warm-up, note DVM reading.

c. Repeat the measurement 48 hours later. If the voltage at TP2 has changed by more than 700 μV, replace the A1 board. Otherwise replace the 10757-60301/2/3 cable assembly.

8-E-17. If the instrument is more than 1°C out of specification:

a. Connect the 10757-60001 board to the 5508A and switch it on.

b. Verify that + and -15 Volts (±0.7 Volt) appear on the A1 board.

c. Verify that U2 pin 3 is at 0V ±2 millivolts. If any of these voltage checks fail, replace the 10757-60304 connector cable. Otherwise, proceed.

d. Remove the 10757-60301/2/3 cable assembly from the 10757-60001 Board.

e. Measure resistance from the black lead to the white lead and from the black lead to the red lead. The sensor cable is OK if both resistances are between 2K and 3K (at room temperature), and

$$\frac{Rbw - Rbr}{0.5\ (Rbw + Rbr)} = 0.02$$

where:

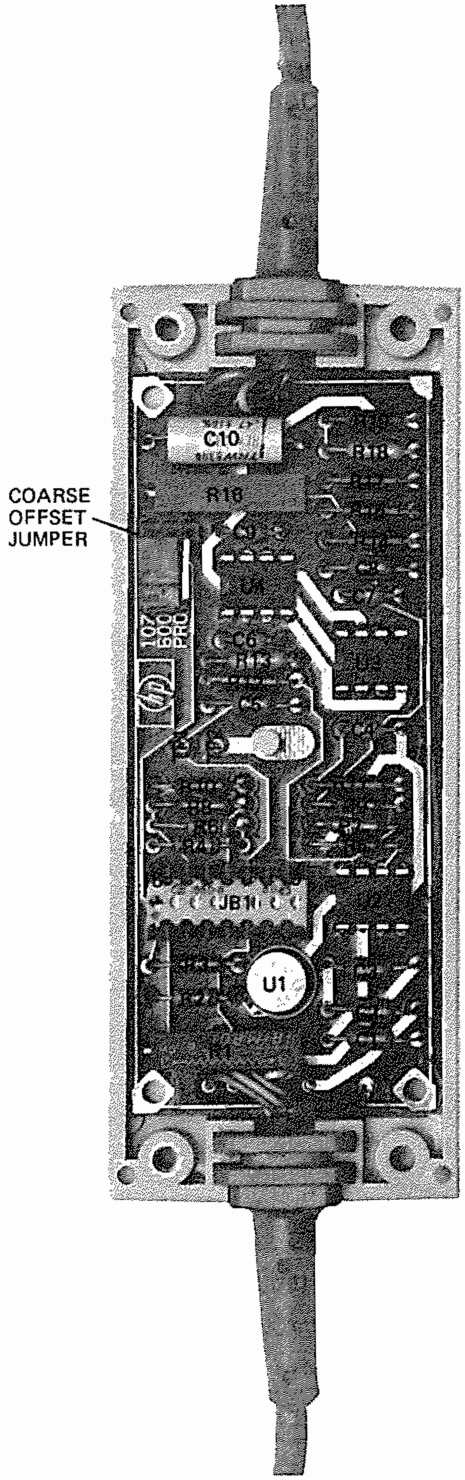
Rbw = Resistance between black lead and white lead, etc.

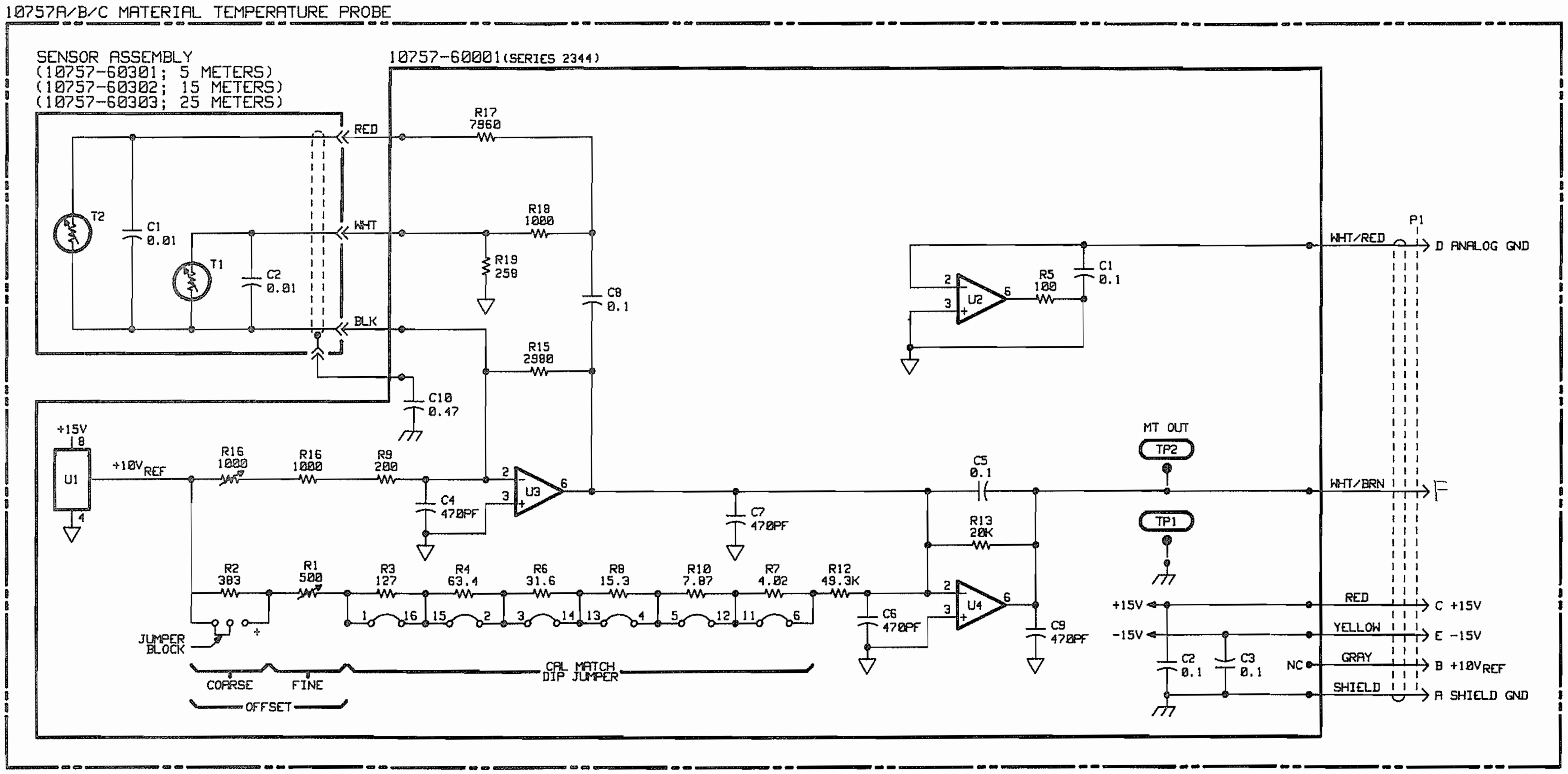
f. Next, connect the DVM - lead to TP1. Set A1R1 and A1R16 fully counterclockwise, and the coarse offset jumper to "+"

g. Replace the existing cal match DIP jumper with one which has been punched as:

P
U Where P = a punched (broken) conductor
U and U = an unpunched (unbroken) conductor
U
U
U
U
U

h. Check the voltage at TP2. If it is not between 2.05 Volts and 2.30 Volts, replace A1.


COARSE OFFSET JUMPER
C10
R18
U4
U3
JB1
U1


10757A/B/C MATERIAL TEMPERATURE PROBE
SENSOR ASSEMBLY
(10757-60301; 5 METERS)
(10757-60302; 15 METERS)
(10757-60303; 25 METERS)
10757-60001(SERIES 2344)
T2
C1 0.01
T1
C2 0.01
RED
WHT
BLK
R17 7960
R18 1000
R19 250
C8 0.1
R15 2980
C10 0.47
+15V
8
U1
4
+10V_REF
R16 1000
R16 1000
R9 200
2
3
U3
6
C4 470PF
C7 470PF
R2 383
R1 500
R3 127
R4 63.4
R6 31.6
R8 15.3
R10 7.87
R7 4.02
R12 49.3K
1 16 15 2 3 14 13 4 5 12 11 6
JUMPER BLOCK
COARSE
FINE
OFFSET
CAL MATCH DIP JUMPER
C6 470PF
2
3
U4
6
R13 20K
C5 0.1
C9 470PF
2
3
U2
6
R5 100
C1 0.1
MT OUT
TP2
TP1
+15V
-15V
C2 0.1
C3 0.1
NC
P1
WHT/RED
D ANALOG GND
WHT/BRN
F
RED
C +15V
YELLOW
E -15V
GRAY
B +10V_REF
SHIELD
A SHIELD GND

NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN MICROFARADS;
   INDUCTANCE IN MICROHENRIES.
3. ASTERISK (*)INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.

REFERENCE DESIGNATIONS
A1 C1-10 JB1 R1-19 S1 TP1-2 U1-4

TABLE OF ACTIVE ELEMENTS

REFERENCE DESIGNATION	HP PART NO.	MANUFACTURER PART NO.
U1	1826-0650	AD 584KH
U2-4	1826-0635	1826-0635

Figure 8-E-2. 10757A/B/C Material Temperature Sensor

Figure 8-E-2
10757A/B/C MATERIAL TEMPERATURE SENSOR

(See Page 8-E-5)

SECTION VIII-F
OPTICS

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  Flatness Measurement Theory 8-F-1

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  Cleaning Measurement Optics 8-F-3

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SECTION VIII-F
OPTICS

8-F-1. INTRODUCTION

8-F-2. This section contains dimensional drawings for the Measurement Optics as shown in Figures 8-F-1 through 8-F-9. Also included is supplemental theory of operation for the Angular and Straightness Measurements. Linear measurement theory is discussed in Section 8A and should be studied before reading the following theory supplements. Troubleshooting and cleaning information is given in Paragraph 8-F-18, Measurement Optics Repair.

8-F-3. ANGULAR AND FLATNESS MEASUREMENTS

8-F-4. 10770A Angular Interferometer

8-F-5. The Angular Interferometer used in Angular and Flatness measurements is basically a Linear Interferometer with a Beam Bender located above it, see Figure 8-F-1 Angular Measurements.

8-F-6. 10771A Angular Reflector

8-F-7. The Angular Reflector contains two Retroflectors spaced at a precisely-known distance, see Figure 8-F-4, Angular Measurement Optics Dimensions.

8-F-8. Angular Measurement Theory

8-F-9. Referring to Figure 8-F-1, the Angular Optics create two parallel beam paths between the Angular Interferometer and the Angular Reflector; one path is laser frequency f1, the second path is laser frequency f2. The distance between these two paths (distance d in Figure 8-F-1) is precisely known since the two Retroreflectors are precisely positioned within the Angular Reflector. Initially, the angle between the Angular Interferometer and the Angular Reflector is assumed to be "0".

8-F-10. If either the Angular Interferometer or the Angular Reflector is tilted, the lengths of the two paths will change; this change will be recorded as phase modulation of both f1 and f2 where they recombine at the Angular Interferometer. Phase modulation is detected and recorded by the 5508A Measurement and Reference Frequency Pulse Counters in the same way as for Linear Measurements (See paragraph 8-A-11, 5508A Measurement Display).

8-F-11. Phase modulation causes the 5508A Measurement and Reference Frequency Pulse Counters to accumulate a difference in count. This count difference is multiplied by an Angular Mode Constant (stored in the 5508A) so that it is displayed in units of angular measurement.

8-F-12. Flatness Measurement Theory

8-F-13. The 10759A Footspacing kit is required to adapt the Angular Measurement Optics for flatness measurements. The footspacing kit contains footspacing pads that are machined such that their footspacing is precisely known. For example, a footspacing pad can be attached to the bottom of the 10771A Angular Reflector to allow measurement of the flatness of a surface. Knowing the footspacing, the 5508A Angular Data can be corrected to obtain flatness data in Linear Measurement Units. See the 5508A User's Guide for procedures required to make Flatness Measurements.

8-F-14. STRAIGHTNESS MEASUREMENTS

8-F-15. 10774A Short Range and 10775A Long Range Straightness Interferometer and Reflector

8-F-16. The Straightness Interferometer and Reflector have the same instrument number because they are a matched pair. They must be matched to have the reflector return the two frequency components of the Laser beam directly back into the Interferometer.

8-F-17. The Interferometer splits the two-frequency beam from the Laser Head into its two component parts; each laser frequency component leaves the Straightness Interferometer along a specific, precisely controlled path. See Figure 8-F-2 Straightness Measurements. This is possible because the Interferometer contains a Wollaston prism, which has a different index of refraction for each laser beam polarization (f2 and f1 are linearly polarized and orthogonal to each other). Each beam from the Straightness Interferometer is directed to one mirror of the Straightness Reflector. The Straightness Reflector consists of a pair of front-surface plane mirrors, rigidly mounted such that they reflect each beam back along its incoming path to the interferometer.

8-F-18. Straightness Measurement Theory

8-F-19. Referring to Figure 8-F-2, the two laser beam paths from the Interferometer to the Reflector (f1 and f2) have some length relative to each other. If the Straightness Interferometer of the Straightness Reflector is moved side-to-side in the Y direction, relative lengths of the two laser beam paths will change. This change will be recorded as phase modulation of both f1 and f2 where they recombine at the Straightness Interferometer. Phase modulation is detected and recorded by the 5508A Measurement and Reference Frequency Pulse Counters in the same way as for Linear Measurements (see paragraph 8-A-11, 5508A Measurement Display). This count difference is multiplied by a Straightness Mode Constant (stored in the 5508A) so that it is displayed accurately in units of Linear Measurement.

8-F-20. OPTICAL REPAIR

8-F-21. Broken Measurement Optics should be returned to Hewlett-Packard. If the housings or optical components of any of these instruments are visibly damaged they will be evaluted for repair. Faulty optics should be carefully identified according to procedures in Section 8-A before returning them to Hewlett-Packard. In particular, paragraph 8-A-70, 5518A Isolation Procedure lists failure indications and displayed error messages that can be caused by the Measurement Optics, the 5518A, or the 5508A. Verifying proper operation of the 5518A and 5508A according to these procedures may be sufficient to isolate problems to a particular Optical Instrument or operator error. Troubleshooting steps for the various types of measurements are listed below.

a. Straightness Measurement Problems:

   1. Use Paragraphs 8-A-70, 5518A Isolation and 8-A-73 Straightness Measurements to verify that the 5518A works properly in STRAIGHTNESS mode.

   2. If the 5518A checks out properly, consult the 5528A User's Guide to verify proper user operation.

b. Angular/Flatness Measurement Problems

   1. Use Paragraphs 8-A-70, 5518A Isolation and 8-A-77 Angular/Flatness Measurements to verify that the 5518A works properly for Linear Measurements.

   2. If the 5518A checks out properly, consult the 5528A User's Guide to verify proper user operation.

c. Linear Measurement Problems

1. Use Paragraphs 8-A-70, 5518A Isolation and 8-A-75, Linear Measurements to verify that the 5518A works properly for Linear Measurements.
2. If the 5518A checks out properly, consult the 5528A User's Guide to verify proper user operation.

8-F-22. Procedures for Cleaning Measurement Optics

WARNING

THE FOLLOWING OPTICAL CLEANING PROCEDURES DO NOT APPLY TO THE OPTICS OF THE LASER HEAD. CLEANING OF THE LASER HEAD OPTICS IS RARELY REQUIRED AND REQUIRES ACCESS TO THE INTERIOR OF THE INSTRUMENT WHERE HIGH VOLTAGES CAN BE PRESENT. ALL LASER HEAD MAINTENANCE SHOULD BE PERFORMED BY A QUALIFIED TECHNICIAN WHO IS AWARE OF THE HAZARDS INVOLVED.

8-F-23. If an optical instrument is visibly dirty on its optical surfaces, the following cleaning procedures should be used.

8-F-24. The optics should be handled with care so that nothing comes in contact with the exposed glass surfaces. Fingerprints will collect dust and dirt which will attenuate and disperse the laser beam. Cleaning the optics should be avoided unless the signal intensity of the beam is noticeably reduced as indicated by the BEAM STRENGTH meter.

8-F-25. If cleaning of the optics is required, be careful to avoid rubbing particles into the coated surfaces. Permanent reduction of signal density could result. If particles are observed on the optics surface, remove by blowing off with clean pressurized air or preferably dry nitrogen. If unavailable, commercially available products such as Kodak Laboratory Sprayer or Micro Duster TX 600 from the Texwipe Company may be used. Each optical instrument is shipped with a package of lens tissue which is made specifically for cleaning optics. Use these tissues (or equivalent) with a pure industrial grade methanol in the following manner:

1. Fold the tissue into an apprixmate 1 inch square.
2. Wet the tissue with methanol (do not saturate) and gently wipe across optical surface. Use only enough pressure to remove the contaminant.
3. Do not reuse the tissue. For additional cleaning, repeat process with a new tissue.

8-F-26. For optical surfaces hard to reach, the tissue may be held with a clamping tweezer such as a hemostatic forcep. However, care must be taken to not scratch the coated surface. Do not scrub the surface with a dry tissue. Avoid alcohol contamination with the following precautions:

a. Use only new, previously unopened containers. Alcohol absorbs water if left exposed to air. This will result in water spots when the alcohol evaporates.

b. Transfer the alcohol to a squeeze bottle that can be capped and made airtight.

c. Never transfer alcohol back into the original container.

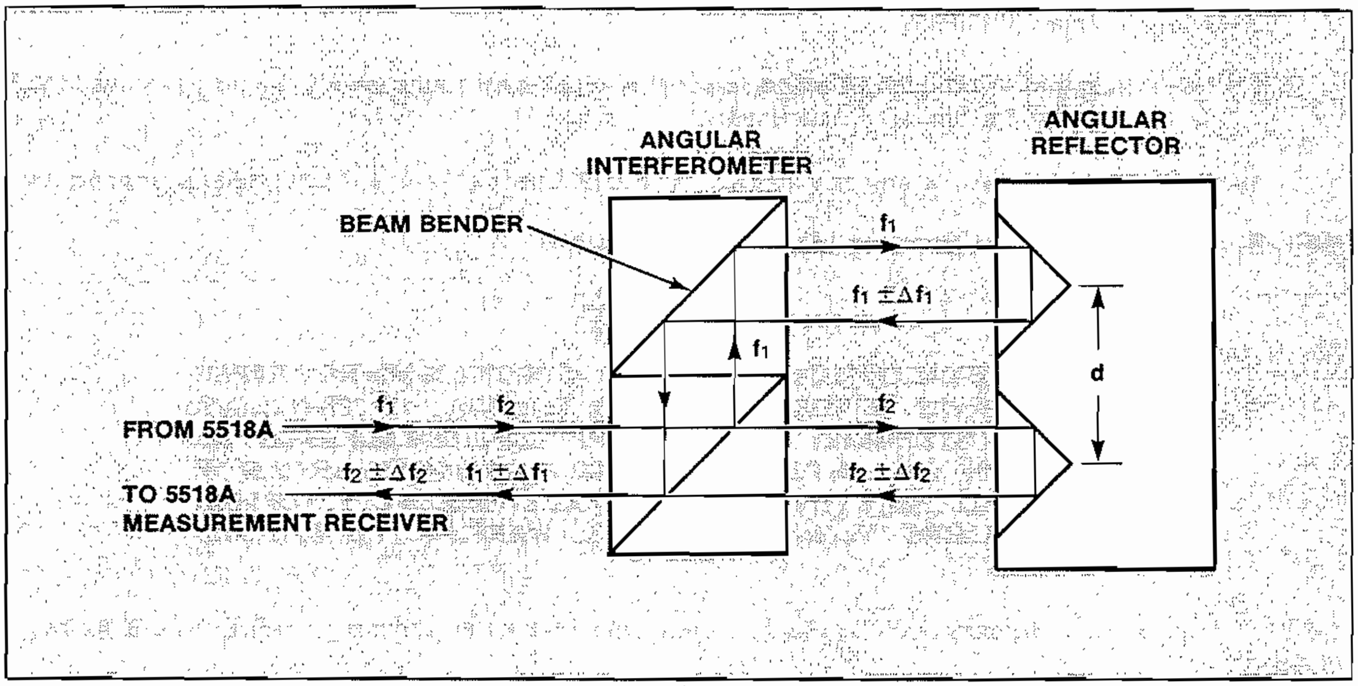

ANGULAR INTERFEROMETER
ANGULAR REFLECTOR
BEAM BENDER
f_1
$f_1 \pm \Delta f_1$
f_1
d
FROM 5518A
f_1
f_2
f_2
$f_2 \pm \Delta f_2$
$f_1 \pm \Delta f_1$
$f_2 \pm \Delta f_2$
TO 5518A
MEASUREMENT RECEIVER

Figure 8-F-1. Angular Measurements

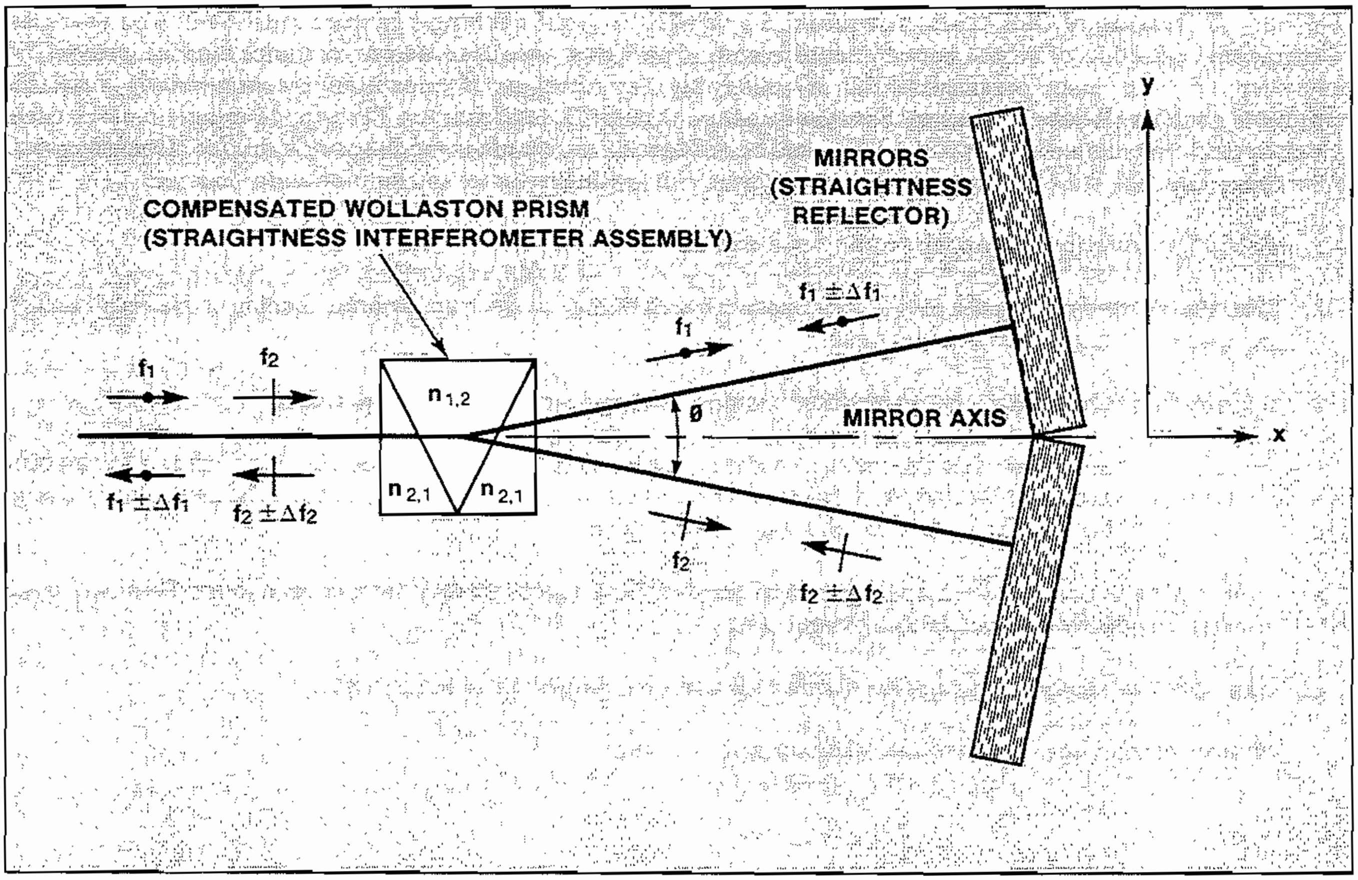

y
MIRRORS
(STRAIGHTNESS
REFLECTOR)
COMPENSATED WOLLASTON PRISM
(STRAIGHTNESS INTERFEROMETER ASSEMBLY)
$f_1 \pm \Delta f_1$
f_1
f_1
f_2
$n_{1,2}$
ø
MIRROR AXIS
x
$f_1 \pm \Delta f_1$
$f_2 \pm \Delta f_2$
$n_{2,1}$
$n_{2,1}$
f_2
$f_2 \pm \Delta f_2$

Figure 8-F-2. Straightness Measurements

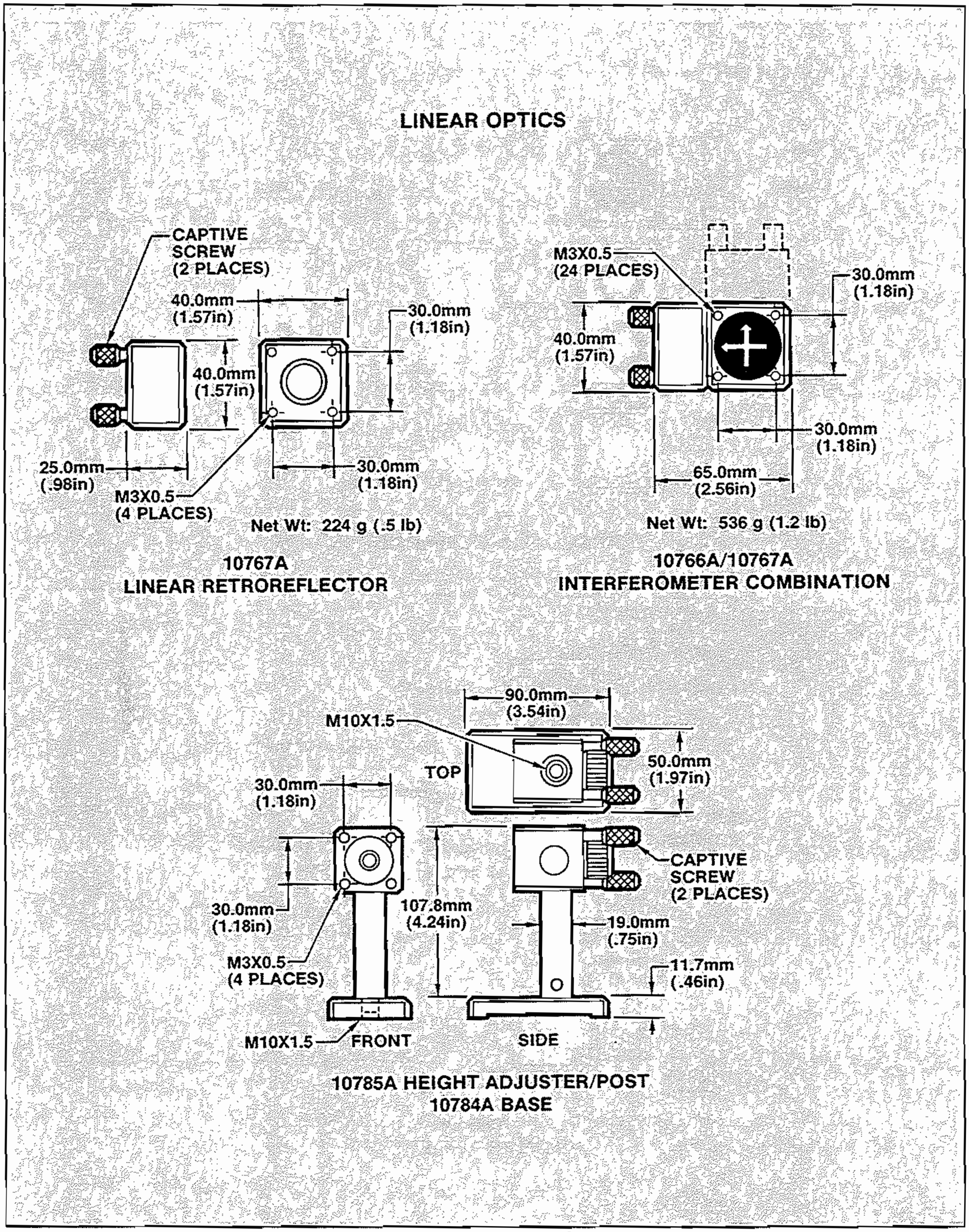
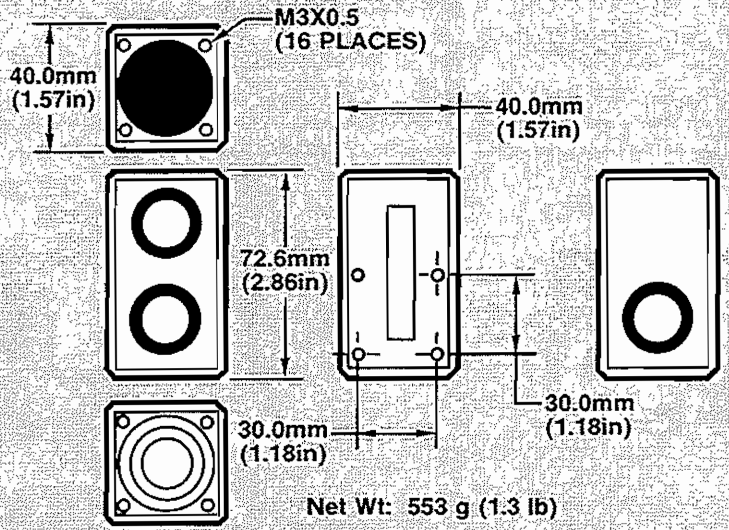
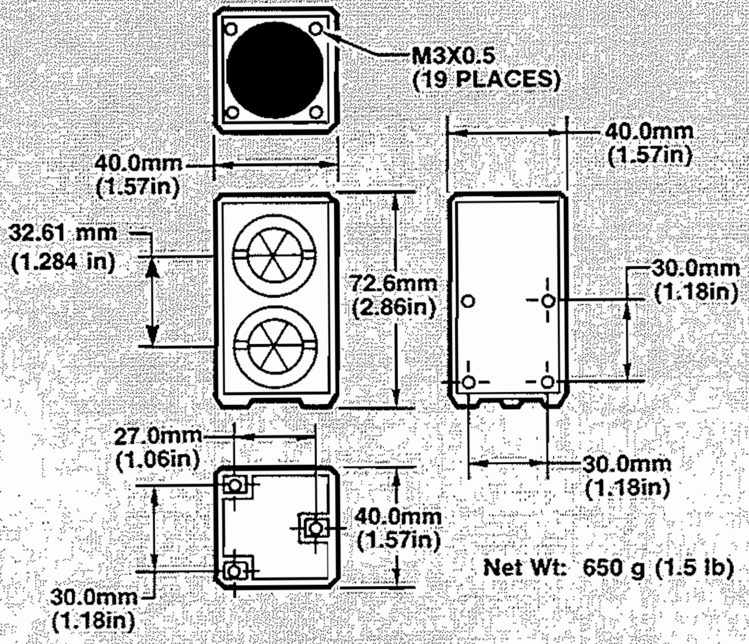

LINEAR OPTICS
CAPTIVE SCREW (2 PLACES)
40.0mm (1.57in)
30.0mm (1.18in)
40.0mm (1.57in)
25.0mm (.98in)
M3X0.5 (4 PLACES)
30.0mm (1.18in)
Net Wt: 224 g (.5 lb)
10767A
LINEAR RETROREFLECTOR
M3X0.5 (24 PLACES)
30.0mm (1.18in)
40.0mm (1.57in)
30.0mm (1.18in)
65.0mm (2.56in)
Net Wt: 536 g (1.2 lb)
10766A/10767A
INTERFEROMETER COMBINATION
90.0mm (3.54in)
M10X1.5
TOP
50.0mm (1.97in)
30.0mm (1.18in)
CAPTIVE SCREW (2 PLACES)
30.0mm (1.18in)
107.8mm (4.24in)
19.0mm (.75in)
M3X0.5 (4 PLACES)
11.7mm (.46in)
M10X1.5
FRONT
SIDE
10785A HEIGHT ADJUSTER/POST
10784A BASE

Figure 8-F-3. Linear Measurement Optics and Accessories Dimensions

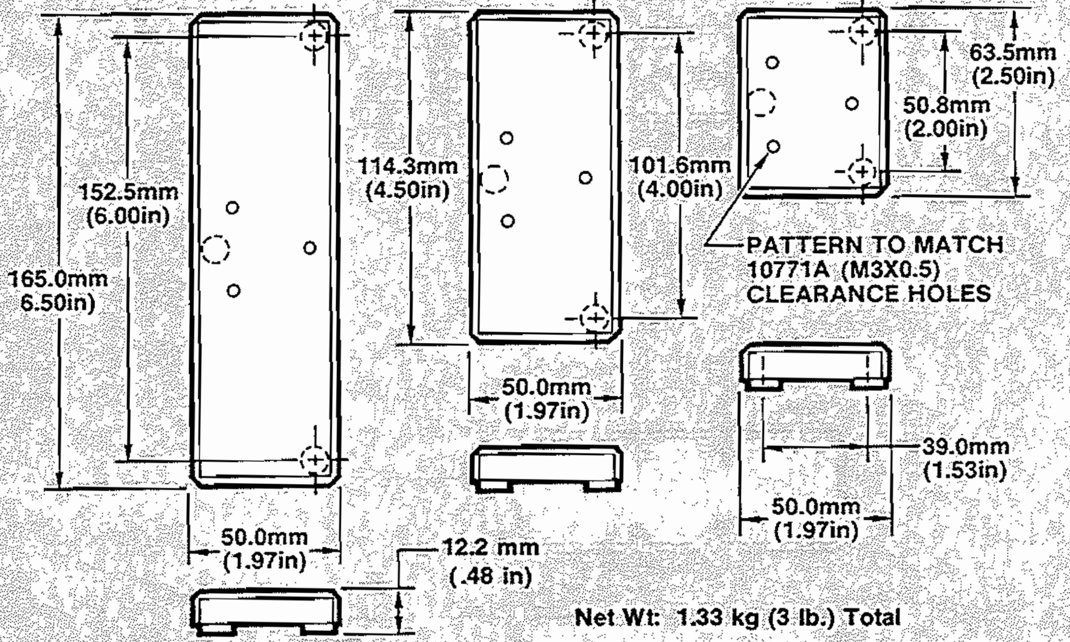

M3X0.5
(16 PLACES)
40.0mm
(1.57in)
40.0mm
(1.57in)
72.6mm
(2.86in)
30.0mm
(1.18in)
30.0mm
(1.18in)
Net Wt: 553 g (1.3 lb)

10770A
ANGULAR INTERFEROMETER

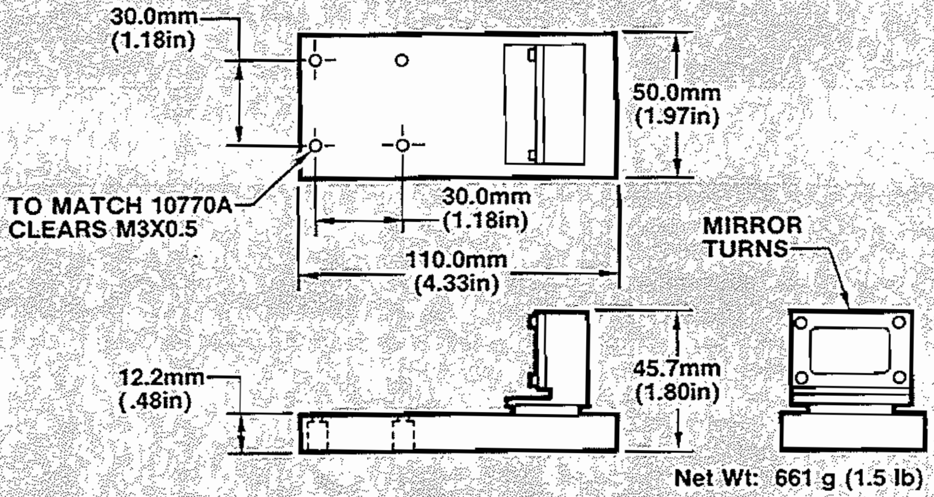

M3X0.5
(19 PLACES)
40.0mm
(1.57in)
40.0mm
(1.57in)
32.61 mm
(1.284 in)
72.6mm
(2.86in)
30.0mm
(1.18in)
27.0mm
(1.06in)
30.0mm
(1.18in)
40.0mm
(1.57in)
30.0mm
(1.18in)
Net Wt: 650 g (1.5 lb)

10771A
ANGULAR REFLECTOR

Figure 8-F-4. Angular Measurement Optics Dimensions


152.5mm
(6.00in)
165.0mm
6.50in)
114.3mm
(4.50in)
101.6mm
(4.00in)
63.5mm
(2.50in)
50.8mm
(2.00in)
PATTERN TO MATCH
10771A (M3X0.5)
CLEARANCE HOLES
50.0mm
(1.97in)
39.0mm
(1.53in)
50.0mm
(1.97in)
50.0mm
(1.97in)
12.2 mm
(.48 in)
Net Wt: 1.33 kg (3 lb.) Total

10759A
FOOT SPACING KIT


30.0mm
(1.18in)
50.0mm
(1.97in)
TO MATCH 10770A
CLEARS M3X0.5
30.0mm
(1.18in)
110.0mm
(4.33in)
MIRROR
TURNS
12.2mm
(.48in)
45.7mm
(1.80in)
Net Wt: 661 g (1.5 lb)

10773A
FLATNESS MIRROR

Figure 8-F-5. Flatness Accessories Dimensions

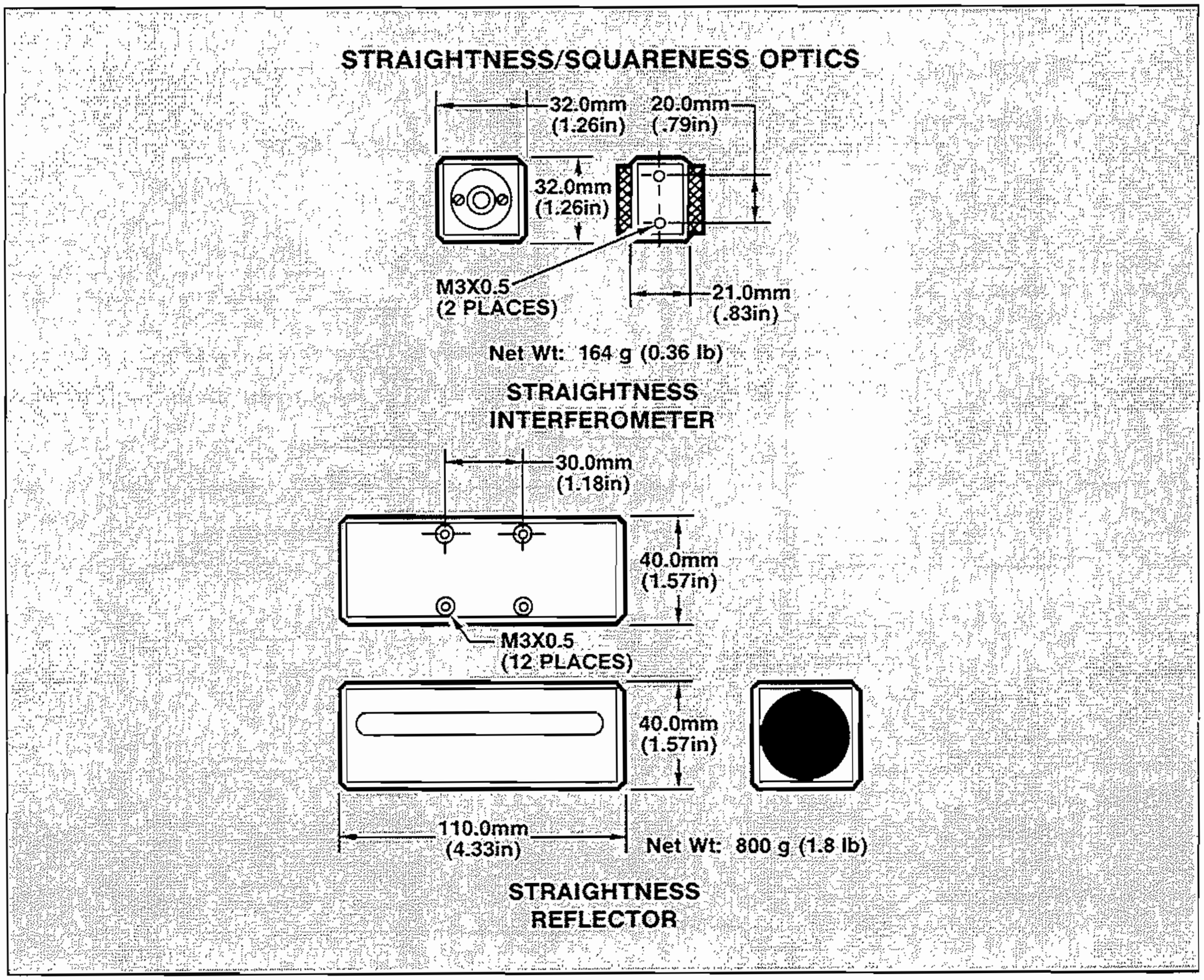

STRAIGHTNESS/SQUARENESS OPTICS
32.0mm (1.26in)
20.0mm (.79in)
32.0mm (1.26in)
M3X0.5 (2 PLACES)
21.0mm (.83in)
Net Wt: 164 g (0.36 lb)
STRAIGHTNESS INTERFEROMETER
30.0mm (1.18in)
40.0mm (1.57in)
M3X0.5 (12 PLACES)
40.0mm (1.57in)
110.0mm (4.33in)
Net Wt: 800 g (1.8 lb)
STRAIGHTNESS REFLECTOR

Figure 8-F-6. Straightness Measurement Optics Dimensions

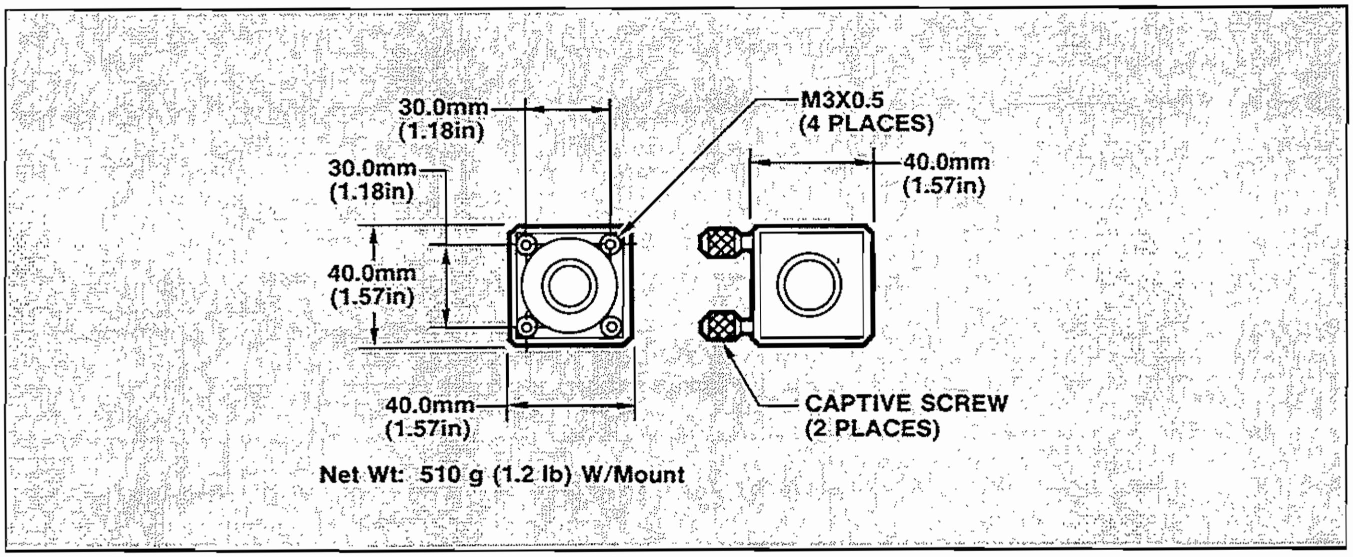

30.0mm (1.18in)
30.0mm (1.18in)
M3X0.5 (4 PLACES)
40.0mm (1.57in)
40.0mm (1.57in)
40.0mm (1.57in)
CAPTIVE SCREW (2 PLACES)
Net Wt: 510 g (1.2 lb) W/Mount

Figure 8-F-7. 10772A Turning Mirror Dimensions

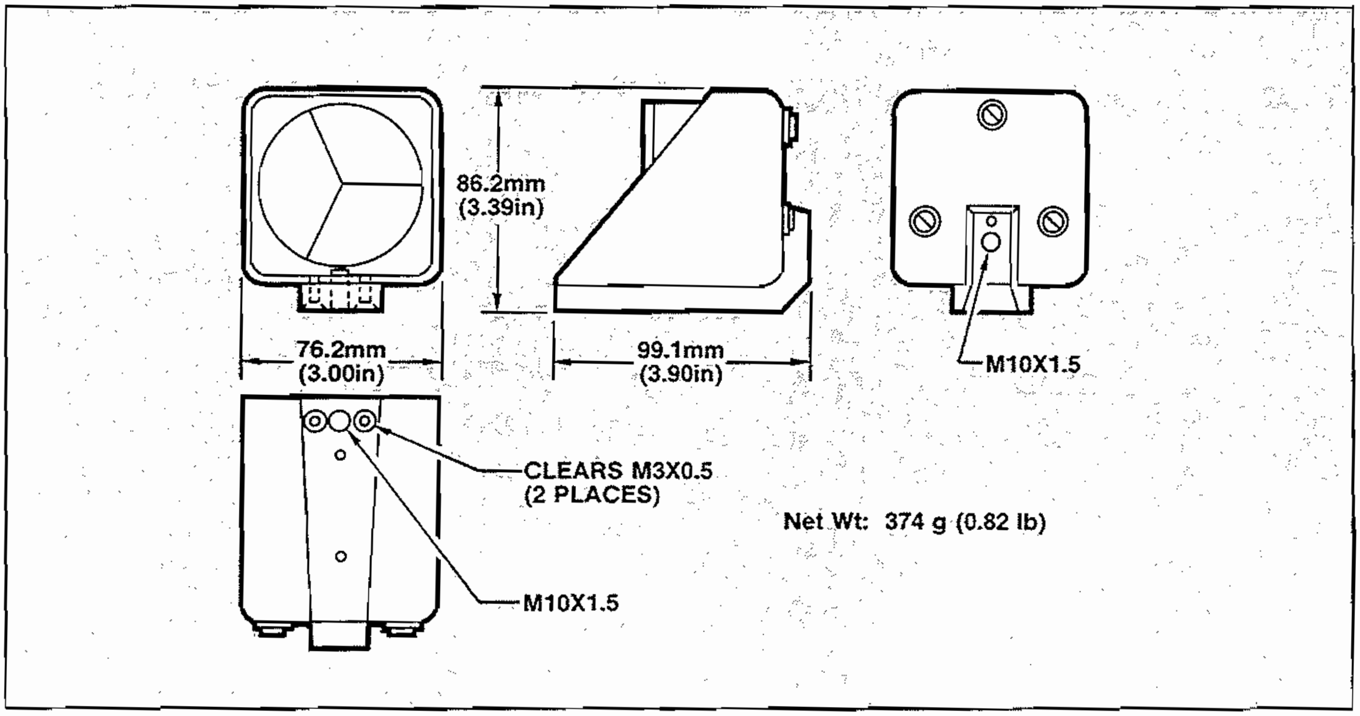

86.2mm
(3.39in)
76.2mm
(3.00in)
99.1mm
(3.90in)
M10X1.5
CLEARS M3X0.5
(2 PLACES)
Net Wt: 374 g (0.82 lb)
M10X1.5

Figure 8-F-8. 10776-67001 Straightness Retroreflector Dimensions

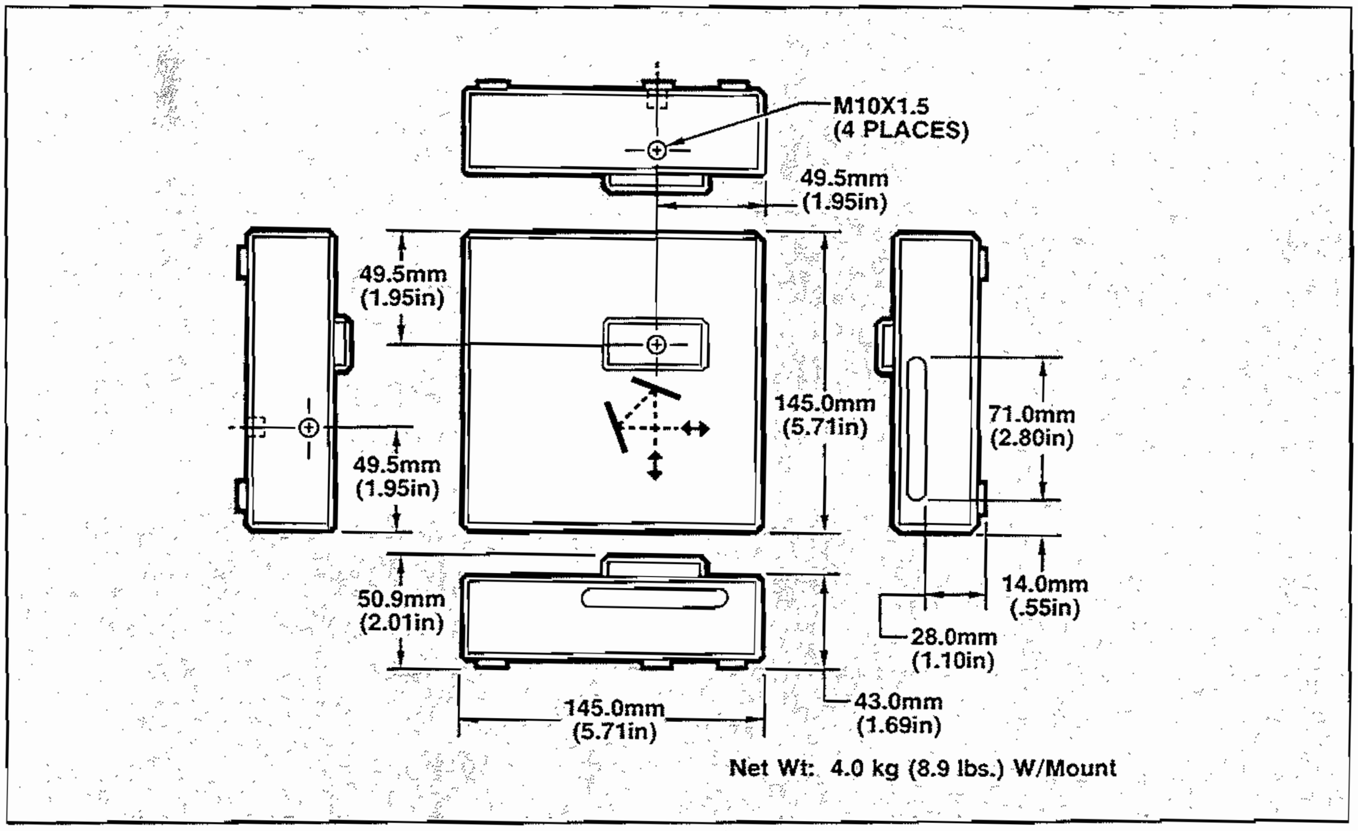

M10X1.5
(4 PLACES)
49.5mm
(1.95in)
49.5mm
(1.95in)
145.0mm
(5.71in)
71.0mm
(2.80in)
49.5mm
(1.95in)
14.0mm
(.55in)
50.9mm
(2.01in)
28.0mm
(1.10in)
145.0mm
(5.71in)
43.0mm
(1.69in)
Net Wt: 4.0 kg (8.9 lbs.) W/Mount

Figure 8-F-9. 10777A Optical Square Dimensions

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DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard Company

Manufacturer's Address:
Santa Clara Division
5301 Stevens Creek Boulevard
Santa Clara, California 95052-8059
U. S. A.

declares, that the product

System/Product Name: Laser Measurement System, 5528A

System Component Model Numbers: 5508A Display, 10751A/B/C/D Air Sensor, 10757A/B/C/D/E/F Material Sensor

Product Options: This declaration covers all options of the product.

conforms to the following Product Specifications:

Safety: IEC 1010-1: 1990 + A1 / EN 61010-1: 1993

EMC:
CISPR 22: 1993 / EN 55022: 1994 Class A
IEC 801-2: 1991 / EN 50082-1: 1992 4 kV CD, 8 kV AD
IEC 801-3: 1984 / EN 50082-1: 1992 3 V/m, 1kHz 80% AM, 27-1000MHz
IEC 801-4: 1988 / EN 50082-1: 1992 1 kV Power Lines, 0.5 kV Signal Lines
IEC 1000-3-2: 1995 /EN61000-3-2:1995 Harmonics, Class A
IEC 1000-3-3: 1994 /EN61000-3-3:1995 Flicker

Supplementary Information:

The product models listed above comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC.

Santa Clara, California, November 7, 1995 Bruce Euler

Bruce Euler, Quality Engineering Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Dept. ZQ/Standards Europe, Herrenberger Straße 130, D-71034 Böblingen (FAX: +49-7031-143143)

DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard Company

Manufacturer's Address: Santa Clara Division
5301 Stevens Creek Boulevard
Santa Clara, California 95052-8059
U. S. A.

declares, that the product

Product Name: Laser Head

Model Number: HP 5518A

Product Options: This declaration covers all options of the product.

conforms to the following Product Specifications:

Safety: IEC 1010-1: 1990 + A1 / EN 61010-1: 1993
IEC 825-1: 1993 / EN 60825-1: 1994 Class 2

EMC: CISPR 22: 1993 / EN 55022: 1994 Class A
IEC 801-2: 1991 / EN 50082-1: 1992 4 kV CD, 8 kV AD
IEC 801-3: 1984 / EN 50082-1: 1992 3 V/m, 1kHz 80% AM, 27-1000MHz
IEC 801-4: 1988 / EN 50082-1: 1992 1 kV Power Lines, 0.5 kV Signal Lines
IEC 1000-3-2: 1995 /EN61000-3-2:1995 Harmonics, Class A
IEC 1000-3-3: 1994 /EN61000-3-3:1995 Flicker

Supplementary Information:

The product models listed above comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC.

Santa Clara, California, November 7, 1995 Bruce Euler

Bruce Euler, Quality Engineering Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Dept. ZQ/Standards Europe, Herrenberger Straße 130, D-71034 Böblingen (FAX: +49-7031-143143)

HEWLETT® PACKARD

If you need technical assistance with a Hewlett-Packard test and measurement product or application please contact the Hewlett-Packard office or distributor in your country.

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Santa Clara, CA 95052-8059
1 (800) 452-4844

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5150 Spectrum Way
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